PC MAGAZINE

SOFTWARE

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FIRST LOOKS

dBASE IV 1.1 Arrives: Did Ashton-Tate Finally Get It Right?

DESKTOP PUBLISHING

Photo Finishers: 6 Gray-Scale Editors Retouch Your Scanned Images

CONNECTIVITY

PC Labs Tests 14 10BaseT LAN Cards: Hidden Costs, Unexpected Benefits

OCTOBER 16, 1990 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 9 NUMBER 17

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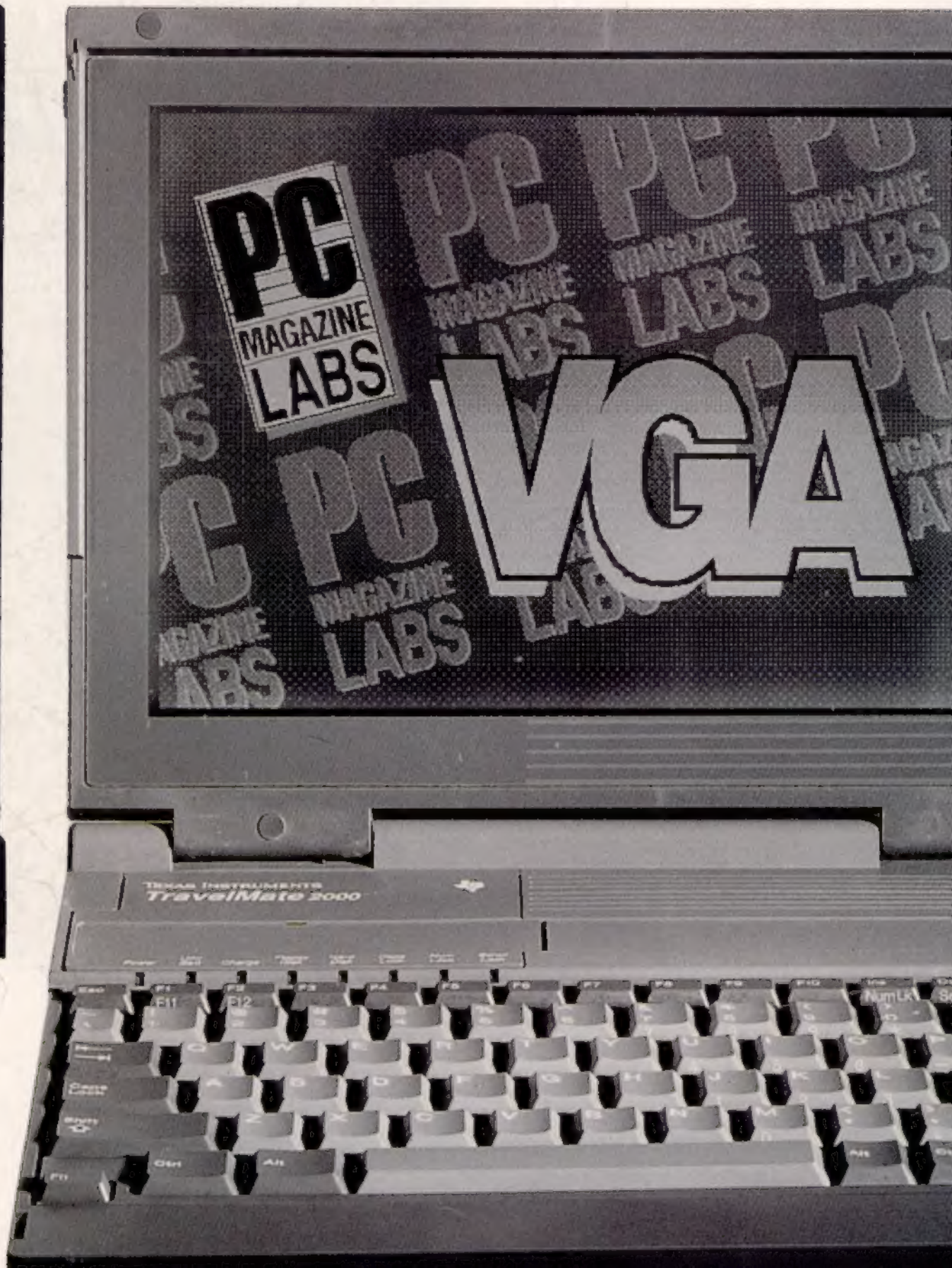

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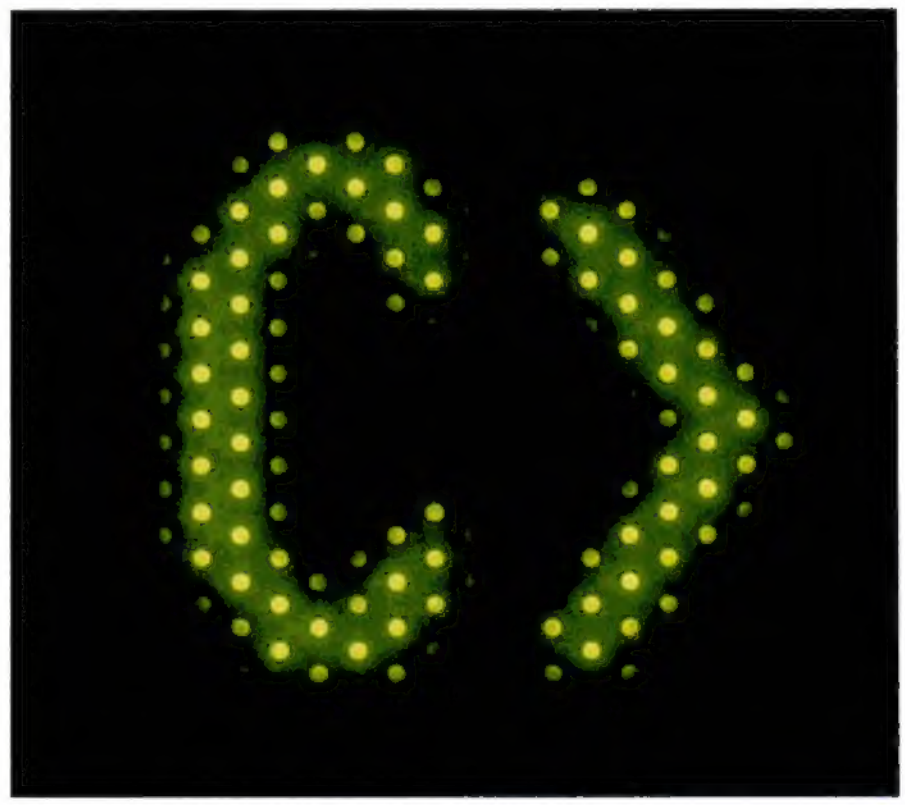

Introducing new Windows 3.0.

The graphical user interface (GUI) environment on an MS-DOS® PC, and subsequent demise of the "C" prompt, is a reality today. Sure, you say.

Microsoft realizes you may have heard this one before. And we agree that you have every reason to be skeptical.

Well, all of this was before new Microsoft® Windows™ version 3.0. A GUI environment that will forever transform the way you use your PC.

Now, before you wonder what to do with all of your existing DOS applications (to say nothing about your existing DOS experience), the Windows environment works within your MS-DOS system. This is not a traumatic thing.

As a matter of fact, once you see the environment created by Windows 3.0, you'll think quite the contrary.

The first time you see it, you won't believe it. Archaic characters, mundane instructions, and even entire command sequences, have been replaced by a program manager full of clear, friendly icons. You're immediately comfortable.

When you work on more than one thing at a time, you'll quickly reap the benefits. Because the program manager welcomes on-screen multitasking of large Windows applications. Of course, without ever visiting the "C" prompt.

Through something with the complicated name of Dynamic Data Ex-

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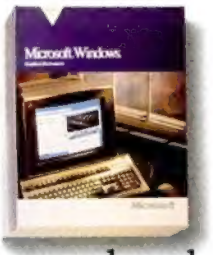
change (DDE), you can simplify your life. For example, with DDE, you can change information in a Microsoft Excel spreadsheet, and have those changes automatically show up in a "linked" table in a word processing document. Or vice versa.



You can also easily access a network from within Windows. So, no matter how big the rivalry between research and accounting is on the softball field, everybody's on speaking terms in the office.

Even the setup program is graphical, only needing a few easy steps.

At this point, you probably think your machine will slow to a crawl the first time you try any of this.

We thought about that, too. So new Windows 3.0 breaks the 640K memory barrier that saddles other DOS programs. Giving you access to all the memory and power your 286 or 386 PC can muster.

It all sounds incredible. Which it is. And, it's taking place in an intuitive, consistent graphical environment.

For more information or to learn about upgrading your current Windows version, call (800) 323-3577, Dept. K85.

Graphics-based software is how people will run their PCs in the 1990s.

And there's no better way to get yourself acquainted than Windows 3.0.

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Microsoft Windows 3.0 is optimized for 1-2MB 286 and 386 personal computers. 640K RAM required. Customers inside the 50 United States, call (800) 323-3577, Dept. K85. In Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661.
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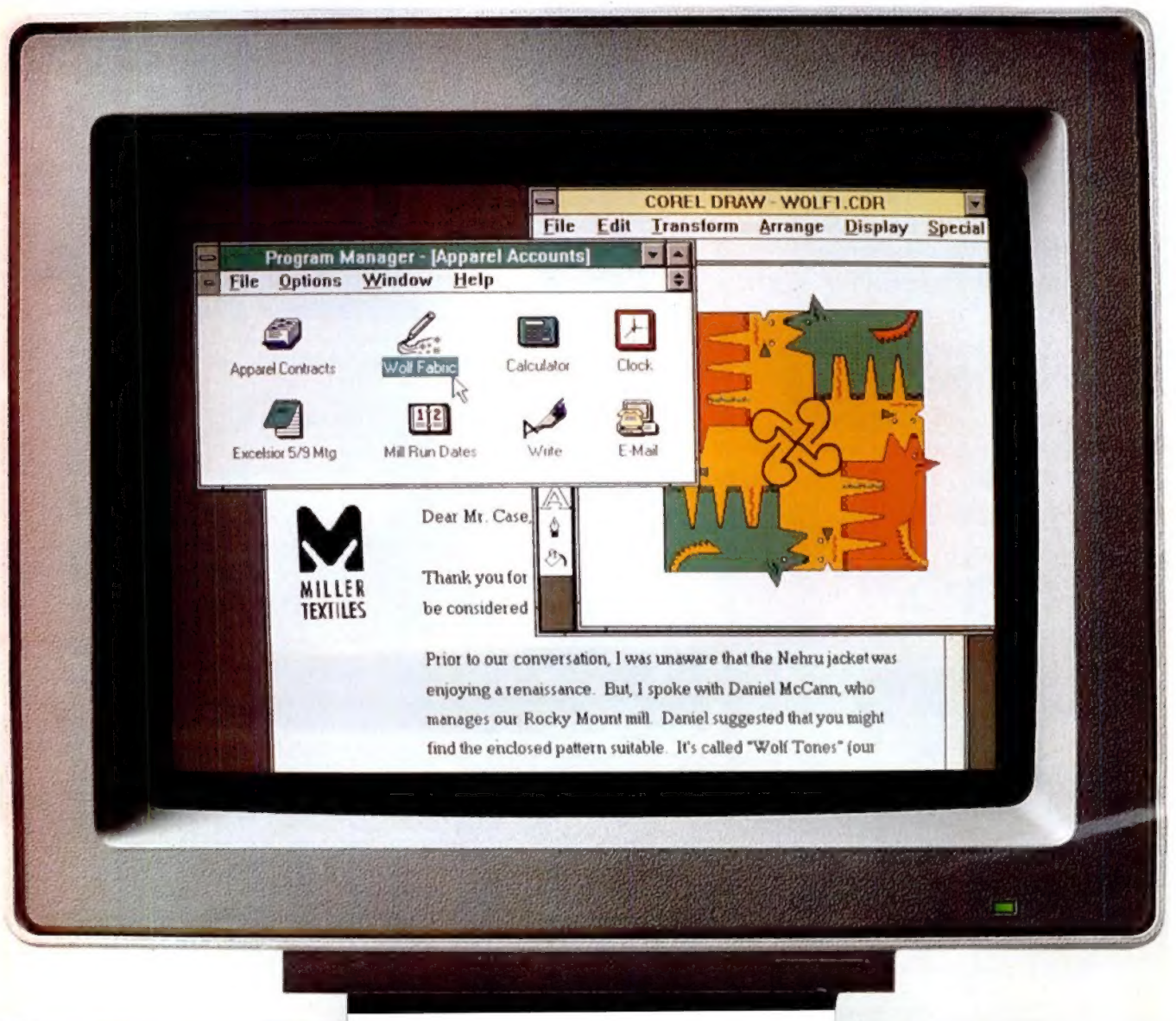

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Inside

How times change. Six months ago, when *PC Magazine* took on 73 portables in a special issue (March 13, 1990), there were only a handful of battery-powered 386 and 386SX systems on the market. Since that time, many other manufacturers have joined in the race to make high-end, truly portable computers—as opposed to transportable, AC-only machines—a reality. In this issue's cover story, "Power Portables: The Next Wave," we review one new 386- and eight new 386SX-based battery-powered systems. The list keeps on growing, too: nearly a dozen of the battery-powered, 386SX-class systems were shipped too late to be included in this issue, although we're sure to catch them the next time around.

Leading the latest roundup of 386-class power portables and 286-based notebook machines is associate editor Julie Cohen.

It's a new world in the notebook class arena, as well. While the SX is taking over from the 286 as the chip of choice on power portables, the 286 chip is increasingly seen in notebook machines. The Compaq LTE/286 was the only 286 system weighing in at under eight pounds in our portables issue; it now faces competition from Toshiba, Sharp, and Texas Instruments.

The portable marketplace isn't the only area where we're seeing new players, either. Starting with this issue, the editorial side of *PC Magazine*'s computer and workgroup systems stories will be headed by associate editor Julie Cohen. In the past, Cohen worked for a consumer electronics magazine where she specialized in mobile electronics like car stereos and cellular telephones.

"Actually, there's a connection between the world of mobile communications and portable computing," says Cohen. "One of the issues in mobile electronics is how to use cellular technology as an extension of the office—how to bring the office into your car. Portable PCs have already made, and will continue to make, the mobile office a reality on another level. Companies are putting everything into smaller, lighter packages that can deliver almost the same power as a desktop system."

Cohen's first assignment as the workgroup systems associate brings her back into the world of telecommunications... well, sort of. This time, the focus is on the 10BaseT standard. Its appeal is that it gives LAN managers the option to use installed telephone wiring, thereby eliminating much of the worry over installation problems and high costs.

In this issue, we also examine 386 multitasking systems and clue you in on SCSI peripherals, a hot topic since the introduction of IBM's latest PS/2 Model 80 with a built-in SCSI port that's fostering endless third-party possibilities.— **Jennifer Zaino** ■

PHOTOGRAPHY: THOM O'CONNOR

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PC MAGAZINE®

October 16, 1990

Volume 9 Number 17

UP FRONT

4 **INSIDE**

15 **LETTERS**

27 **ADVISOR**
Lori Grunin/ Plugging a PS/2 keyboard into a clone; sharing CD-ROM drives; clarifying your software rights.

33 **FIRST LOOKS**
dBASE IV 1.1: Too little, too late for Ashton-Tate.
Hewlett-Packard LaserJet IIID: HP continues the tradition.
Norton Utilities 5.0: An old friend puts on a new face.
LetterPerfect: WordPerfect shrinks to fit a different user.
Thinx: Bell Atlantic's database with a graphical twist.

55 **NEW AND IMPROVED**
Rink Murray

63 **READ ONLY**
Matthew J. Ross

65 **PIPELINE**
Gus Venditto

73 **BILL MACHRONE**
Upgrading the Installed Base

79 **JOHN C. DVORAK**
The Japan, Inc. Hoax

81 **Inside Track**

85 **JIM SEYMOUR**
The "Slate PC" Wave Is About to Break

93 **WILLIAM F. ZACHMANN**
Cost-Justifying Computers

COVER STORY

99 **COMPUTERS**
Power Portables: The Next Wave
Bill Howard/ The latest round of portable PCs proves faster, lighter, and better than earlier models. Here are ten new 386SXs and DXs and four of the lightest 286 notebooks money can buy.

112 Compaq LTE/286
126 Sharp PC-6220/ TI TravelMate 2000
141 Toshiba T1200XE
142 Arima ACT 386SX-420
147 Compaq SLT 386s/20
148 Data General Walkabout/SX
151 Epson Equity LT-386SX
157 GRID 1450sx
162 Impulse SX
167 ITC 386 PEP
172 Toshiba T3100SX
175 Twinhead Superlap SX
176 Zenith TurboePort 386e

101 **Editor's Choice**
102 **MNP, CCITT, V-dot-22-bis, and Lap-M: Won't Somebody *Please* Speak English?**
125 **A New Twist for Laptops**
130 **Features Table**
144 **Performance Tests**

FEATURES

191 **SOFTWARE**
386 Multitasking Environments: Making DOS Work Overtime
Brian Carr/ DESQview 386, Microsoft Windows 3.0, *Omniview 386, VM/386 MultiTasker,* and *Vmos/3* let you take your 386 processor and split it into several virtual PCs. The result: a productivity increase.

210 **A Decision Guide to Multitasking Solutions**
196 **DOS Extenders to the Rescue**
192 **Editor's Choice**
202 **Features Table**
214 **Performance Tests**

237 **GRAPHICS**
Between Black and White: Six Gray-Scale Editors
Alfred Poor/ Six products that allow you to alter photographic effects such as contrast and brightness in gray-scale images give your desktop-published documents a professional look.

240 *Gray F/X*
247 *ImagEdit*
248 *Image-In*
252 *PC Paintbrush IV Plus*
257 *Picture Publisher*
260 *ZIP Image Processing*

238 **Editor's Choice**
240 **How Many Shades?**
254 **Features Table**
245 **A Sampling of Effects**

FEATURES

269 HARDWARE
QIC 150 Tape Drives: The Rising Star for Backup
M. David Stone/ PC Labs tests 23 QIC 150 tape drives, which provide backup solutions for today's users.

- 286 Alliance QA150-EXAT
- 292 Bi-Tech 150 SCSI Tape Kit QIC
- 292 CMS Enhancements TapeMaster 150E
- 300 Colorado Memory Systems QFA500
- 302 Compaq 150/-250- Megabyte Tape Drive
- 303 COREtape CT150/250E
- 309 Emerald Systems RapidRecover 150 Model RAP150-9000
- 314 Everex Excel Stream 150
- 314 Identica IDT150
- 317 Irwin 6451-E
- 317 MaynStream 150Q
- 318 MicroNet MT-150/DOS
- 320 Mountain FileSafe 7250
- 320 NCR 6091 150 MB SCSI Tape SubSystem
- 323 NovaStor NST150
- 323 Osicom Osibak 150S
- 329 Sankyo ET 150 E
- 329 Sysgen Maxi TS250e
- 330 Tallgrass FSO 150e
- 330 Tandberg Data Panther 150
- 334 Tecmar QT-150e
- 336 TLC Legacy 150x²
- 338 Wangtek LS 5150 PK

272 Editor's Choice
294 Features Table
302 Performance Tests

341 PERIPHERALS
SCSI: An Interface Whose Time Has Come
Robert W. Kane/ Now that the latest PS/2 sports a SCSI port, the time is ripe for the SCSI interface.

359 CONNECTIVITY
Building Workgroup Solutions: 10BaseT LANs
Frank J. Derfler, Jr./ The best cabling for your LAN can be as simple as hooking up your telephone.

- 368 AT&T Computer Systems
- 373 Cabletron Systems
- 376 David Systems
- 381 DCA 10NET Communications
- 382 Everex Systems
- 383 Gateway Communications
- 386 Hewlett-Packard Co.
- 390 IMC Networks Corp.
- 392 NetWorth
- 395 Standard Microsystems Corp.
- 396 3Com Corp.
- 396 Western Digital Corp.

360 Editor's Choice
386 Features Table
391 Performance Tests

506 Direct Marketing Connection
526 Marketplace
529 Reader Service Card
553 Coming Up
554 Advertisers' Product Index
556 Editorial Product Index
559 Index to Advertisers

PRODUCTIVITY

403 LAB NOTES
PC Scanners: Not Just for High-end Users Anymore/*Roger Alford*

425 UTILITIES
PCBOOK Makes Your LaserJet Print Files in Booklet Form/*Jay Munro*

449 ENVIRONMENTS
Working with Metafiles: Modifying and Sharing Vector-Oriented Images/*Charles Petzold*

461 POWER PROGRAMMING
The Successor to DOS: A Look at Several Possibilities/*Ray Duncan*

471 WINDOWS
William S. Hall/ Beware of problems with some versions of *PC Tools* and certain DOS programs.

477 DATABASES
Trudy Neuhaus/ Explore the two main methods of storing data when indexing with BASIC.

483 SPREADSHEETS
Craig Stinson/ An alternative to the Paste Special command; rediscover keystroke shortcuts.

487 THE WORKING WORD
Craig L. Stark/ Count the occurrences of a word in *WordPerfect, Word,* and *XyWrite.*

491 USER-TO-USER
Neil J. Rubenking/ An undocumented DOS 4.0 command; transform your Caps Lock key.

497 TUTOR
Jeff Prosise/ Understand why there are variations among null-modem cables; identify your NDP.

503 CONNECTIVITY
Frank J. Derfler, Jr./ Master the art of logging in to *NetWare;* keep the login script from overwriting your path.

AFTER HOURS

557 ■ Three programs that help you keep track of your weight.
562 **ABORT, RETRY, FAIL?**/*Bill Howard*

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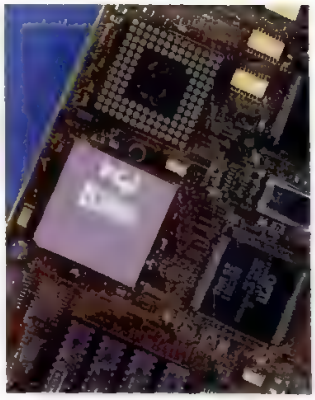

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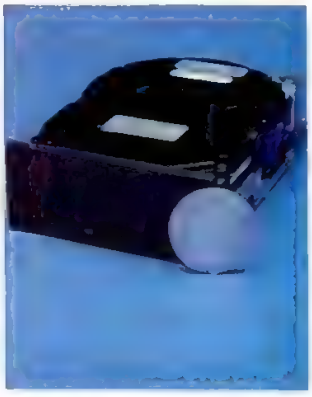

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AUSTIN 286 16 CHALLENGE		
Comparison	Austin	PS/1
Processor	286 16	286 10
Speed	30% Faster	
RAM	1MB	640K
Floppy Drive	5.25" & or 3.5"	1-3.5" Only
On-Site Service	Yes	No
Expansion	5 Slots	3 Slots
Availability	Nation-wide	3 cities only
Price	$1290	$1699

Source: IBM PS/1 Press Release

Austin 286/16 Comparison Chart

Austin American-Made Motherboard.

Unlimited Toll-Free Technical Support.

ALL READY

Order the Austin 286/16 today, and your system comes to you ready to use right out of the box! Whether you choose the standard configuration or custom design your own system, this small space-saving chassis performs the big tasks at home as well as on the job. That's why it's sure to become America's favorite first computer.

Performing 30% faster than the IBM's newest PS/1, the popularity of the 286/16 is attributed to its make up. Combining the speed of the 80286 16MHz Microprocessor, the standard 40MB Hard Drive and DOS compatibility make this system perfect for personal and small business users. Run a gamut of software, including spreadsheets, database management and even games. Add peripherals to the seven expansion slots and upgrade memory as much as 8MB onboard, to eliminate the fear of system obsolescence.

And privilege of ownership means you'll get 1 year GE On-Site Service, a parts and labor warranty, unlimited toll-free technical support and a 30-day money-back guarantee. You can't lose with a winning offer like that!

AUSTIN 286/16

- VGA Monitor with Video Adapter
- 40MB IDE Hard Drive
- 1MB On-Board RAM
- GE On- Site Service for 1 year

All for only $1290 or $39 monthly.

You also get:

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- Clock with Battery Backup
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- Slimline Chassis
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Upgrade to VGA Color Monitor	$249
Upgrade to 2400 Baud Modem	$149
Upgrade to Microsoft Windows 3.0, MS-DOS 4.01, and Microsoft Mouse	$179

AUSTIN
HAS IT ALL.™

AUSTIN 386/SX

- 14" VGA Color Monitor
- Super- charged VGA Video Adapter (supports up to 1MB VRAM)
- 40MB Hard Drive
- 2MB On-Board RAM
- Microsoft Windows 3.0, MS-DOS 4.01, & Microsoft Mouse
- GE On-Site Service for 1 year

All for only $2190 or $67 monthly.

ALL-STAR

"The Austin 386/SX has it all . . . excellent support and attractive pricing . . . faster-than-average performance, quality components, expansion possibilities and a made in America philosophy . . ." Bruce Brown, PC Magazine Computer Consultant, Editor's Choice 1990.

The system that experts say "has it all . . ." just got more! The Editor's Choice Austin 386/SX now comes fully loaded with a complete multi-tasking Windows package. You'll get Microsoft Windows 3.0, DOS 4.01 and a Microsoft Mouse loaded and ready to run. The 386/SX PowerStation utilizes only high performance components to meet the demands of Windows. It comes standard with 2MB onboard RAM, a 40MB fast transfer IDE Hard Drive, an Austin High Clarity VGA Color Monitor and a Super-Charged VGA Video Display Adapter that supports up to 1MB VRAM. Austin 386/SX . . . the best just got better.

PC Magazine Editor's Choice, January 1990.

GE On-Site Service

The 386/SX 4" Slimline chassis option

You also get:

- 386/SX Intel® Microprocessor
- Dual Floppy/IDE Hard Drive Controller with 1:1 Interleaving
- Floppy Drive (1.4MB or 1.2MB)
- Two Serial and One Parallel Port
- 7 Expansion Slots (1-8 bit and 6-16 bit)
- Enhanced 101 Keyboard with Tactile/Click Touch
- 80387/SX Math Coprocessor Socket
- Built-in Setup Program
- Clock with Battery Backup
- Compatible with DOS, OS/2, and Unix
- American-Made Motherboard
- Small Footprint Chassis
- Complete Documentation
- Unlimited Toll-Free Technical Support Hotline
- 30 Day, No Questions Asked, Money-Back Guarantee
- FCC Class B

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Microsoft Windows Package

Super-charged 1MB Video Display Adapter (Option)

ALL ABOARD

Designed more ambitiously than rival 386/25 systems, the Austin 386/25 Powerstation is built for the most demanding multi-tasking user. The Powerstation comes not only custom-configured to your specifications, but is also fully loaded with Microsoft Windows 3.0, DOS 4.01 and a Microsoft Mouse. It's all there, ready to run from the word "GO!"

And the powerful combination of the standard 2MB RAM, a full-blown 32-bit Intel 80386 Processor and the 110MB Fast Trax Hard Drive, lets it do just that! Even with a multitude of Window applications stored, your Window screens snap into place at your command with split-second precision. Elevate your video performance up to 1 full MB of video RAM and enjoy multi-tasking in multi-color. The Austin 386/25 . . . loaded with features that say it was designed with Windows in mind.

AUSTIN 386/25

▶ 110MB IDE Hard Drive with 32K Cache ▶ 14" VGA Color Monitor ▶ Super-charged VGA Video Adapter (supports up to 1 MB VRAM) ▶ 2MB On-Board RAM ▶ Microsoft Windows 3.0, MS-DOS 4.01, & Microsoft Mouse ▶ GE On-Site Service for 1 year All for only $2890 or $87 monthly.

You also get:

- 386/DX Intel® 25MHz Microprocessor
- Dual Floppy/IDE Hard Drive Controller with 1:1 Interleaving
- Floppy Drive (1.4MB or 1.2MB)
- Two Serial and one Parallel Port
- 7 Expansion Slots (1-8 bit and 6-16 bit)
- Enhanced 101 Keyboard with Tactile/Click Touch
- 80387 Math Coprocessor Socket
- Clock with Battery Backup
- Compatible with DOS, OS/2, and Unix
- American-Made Motherboard
- Small Footprint Chassis
- Complete Documentation
- Unlimited Toll-Free Technical Support Hotline
- 30 Day, No Questions Asked, Money-Back Guarantee
- FCC Class B

AUSTIN 386 25 CHALLENGE

Comparison	Austin	Northgate	Dell
Super VGA Color Monitor	800x600	800x600	800x600
Video RAM	1MB	512K	512K
RAM	2MB	2MB	1MB
Hard Drive	110MB	110MB	110MB
Small Footprint Chassis	Yes	No	No
On-Site Service	GE 1 yr	?	Xerox 1 yr
Price Difference	Best Value	29% Higher	42% Higher
Actual Price	$3185	$4090	$4527

Source: PC Magazine 9/11/90

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Upgrade to a 175MB Hard Drive and a Super VGA Color Monitor with 800 × 600 resolution . . . and 1MB VRAM.	$499

AUSTIN HAS IT ALL.™

AUSTIN 486/25

▶ EISA Bus Architecture ▶ 14" VGA Color Monitor ▶ Super-charged VGA Video Adapter ▶ 110MB Hard Drive with 32K Cache ▶ 4MB RAM (expands to 64MB on-board) ▶ Microsoft Windows 3.0, MS-DOS 4.01, & Microsoft Mouse ▶ GE On-Site Service for 1 year All for only $5990 or $180 monthly.

ALL MIGHTY

Power far beyond the standard. That's what the Austin 486/25 is all about. The architecture of this leader extends beyond industry expectations, and takes you into a new dimension of computing. This dynamic ruler, with an Intel i486 Microprocessor as its origin of power, has all essentials built right in. Like 8KB of Internal Cache and Floating Point Unit. Harnessing i486 speed requires the ultimate in power features. That's why we load 4MB of 32-bit High Speed Memory and an Ultra-Fast 110MB Hard Disk with a 32K Cache.

Challenge the 486 to its fullest potential. Power users can add up to 64MB RAM onboard to handle the largest applications. Graphic users can pump up to 1MB Video RAM for 1024 × 768 resolution on a full color spectrum. And if you're after the ultimate fileserver, select one of our massive hard drives to complete your configuration. This Austin EISA powerhouse gives you the performance you demand with the guarantees you expect.

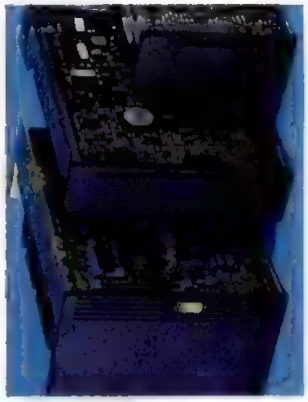
Austin 486/25 EISA Motherboard

486/25 EISA CHALLENGE		
Comparison	Austin	Dell
System RAM	4MB	4MB
System Cache	64K	8
Hard Drive	175MB	190MB
Monitor	Super VGA Color 800x600	Super VGA Color 800x600
Video Adapter	1MB	256K
On-Site	GE	Xerox
DOS Windows 3.0 & Mouse	Yes	No
Price	$6489	$7299

Source: PC Magazine 9/11/90

You also get:

- i486 Intel® 25 MHz Processor
- Internal 8K Cache and Floating Point Unit
- Additional 64K External Cache (expands to 256K on system board)
- Eight 32-bit EISA/ISA compatible slots
- 6 slots available for bus masters
- 4167 Weitek Math Co-Processor Support
- 2 Serial Ports & 1 Parallel Port
- Shadow RAM Caching (BIOS/Video)
- Dual Floppy/Hard Drive Controller with 1:1 Interleaving
- 3.5" 1.44MB or 5.25" 1.2MB Floppy Disk Drive
- Clock with Battery Backup
- Enhanced 101 Keyboard
- Fully Novell, DOS, OS/2, Unix Compatible
- EMS LIMM 4.0 Support
- Landmark v1.14 rating—113.8MHz
- American-Made Motherboard
- 5-Bay DeskTop Chassis
- Complete Documentation
- 1 Year Parts & Labor Warranty
- 30 Day, No Questions Asked, Money-Back Guarantee
- FCC Class A (B pending)



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Or load several sessions of the same program, each with a different file, pop back and forth, and work on several spreadsheets, documents, or anything else, all at once.

Why didn't someone do this before?

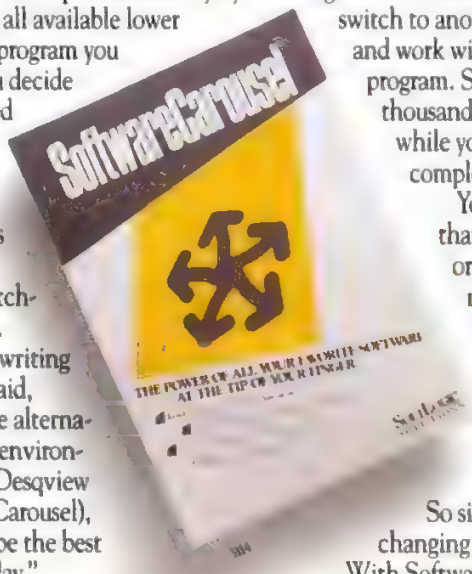
Actually, a lot of people tried. But what they ended with were a bunch of fancy software "environments" that eat up memory, change the way you work, and boggle the mind with complexity.

Plus, a lot of them make you buy new "compatible" software applications. Some even make you buy a bigger computer.

Software Carousel, on the other hand, works with the programs you already own. So you can go on using 1-2-3, WordPerfect, dBASE, SideKick, any program that runs on the computer you use right now. In an absolute minimum of memory. Without changing anything about the way your software runs.

Best of all, Software Carousel makes the most of your computer's memory by letting you use all available lower RAM in each program you use. And if you decide to add extended or expanded memory, Software Carousel works with that too, and makes switching even faster.

Garry Ray, writing for PC Week said, "Of these three alternative operating environments (OS/2, Desqview and Software Carousel), Carousel may be the best choice of the day."



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#6

Letters

END-USER BENEFITS

Good news for Edward Mendelson who wrote the *PC Tools* 6.0 review (First Looks, June 26, 1990). Apparently, Central Point Software agrees with Mendelson that allowing the user to extend the cache write delay beyond 1 second is dangerous.

The company has changed the /WRITE option to recognize only on/off. *On* sets the cache write delay to 1 second. The new version is available from the Central Point Software bulletin board system at (503) 690-6650. It's nice to see a software vendor react so quickly for the benefit of the end user.

Jim Clay
Tampa, Florida

WINDOWS: A SECOND LOOK

As a technical consultant for *Thinx*—a *Microsoft Windows* 3.0 software product currently under development—I have had the privilege to use *Windows* as a tool. Therefore, I feel compelled to comment on the *Windows* 3.0 article (First Looks, July 1990) by Gus Venditto, because it had inaccuracies.

First, Microsoft refers to the collection of programs in a daughter window of Program Manager as a Program Group, not a folder. (Folders are encouraged in File Manager and on Macintosh computers.)

Secondly, the article states that users can install a new .PCX file as a background graphic through the Desktop Options of the Control Panel. This is not true. The graphic must be in the bitmap .BMP format and must be located in the *Windows* 3.0 subdirectory (or you must type in the full pathname). There is still hope for your .PCX files, though. Luckily, *Windows* 3.0 comes equipped with Microsoft's version of *Paintbrush*. *Paintbrush* can open files in the .PCX format and save them in the .BMP format.

I look forward to many more articles on *Windows* 3.0.

Erik C. Metz
Morgantown, West Virginia

Edward Mendelson's First Look at *PC Tools* elicited an immediate response from the manufacturer.

TRADE SHOWS AREN'T WHAT THEY USED TO BE

Each year, I look forward to PC Expo providing me with the news on the "latest and greatest." Years ago it was a source for new thoughts to be presented in a tasteful fashion and discussed among peers.

Now it appears to have a carnival-like atmosphere. Last year, the biggest attraction was a wrestler; this year, the largest line was to shoot a basketball.

I am not necessarily proposing going back to the past, but a forum for pure computer enthusiasts and for those who earn our living from this industry should have a reasonably dignified metropolitan trade show.

Lawrence Malin
Metuchen, New Jersey

WHICH TOOLBOX IS FOR YOU?

Barry Simon's review of symbolic math toolboxes ("The New World of Higher Math," May 29, 1990) misjudges the merits of the *Mathematica* programming language. Having purchased both *Mathematica* and *Maple* a year ago to do symbolic manipulations, I decided to learn the languages. Since I don't have a programming background, I found *Maple*'s language to be very difficult to learn and use.

I had no problem whatsoever with *Mathematica*. Within one week I was writing relatively sophisticated programs for my research. With its outstanding ease of learning and use combined with its "considerable power" and "excellent graphics" as noted by Simon, *Mathematica* is already unbeatable as a mathematical and scientific programming language, both for teaching and research.

Richard J. Gaylord
Urbana, Illinois

PC MAGAZINE I had stated that *Maple* would be simple for those with experience in C or Pascal. I'd like to emphasize that the Editor's Choice decision had nothing to do with languages but with *Mathematica*'s weakness in symbolic manipulation in the released version that I reviewed—for example, its lack of a Risch algorithm. I expect many of these deficiencies will be remedied in Version 2.0, which will run under *Windows* and have the Mac's notebook interface. Since *Maple*'s next version will have vastly improved graphics, it may continue to be a horse race.—*Barry Simon*

RADIO LANS: SCARE TACTICS

Bill Machrone, in his sidebar, "Radio LANs: Threat or Menace?" ("The Next Wave: LANs Without Wires," May 29, 1990) illustrates a lack of understanding of the radio frequency (RF) environment and unnecessarily frightens potential users of radio frequency LANs or other RF devices.

Computers and nearly all other electronic devices generate internal radio frequency signals. In the case of computers, these signals are emitted throughout the radio spectrum and cause interference to AM/FM radio, shortwave radio, police and aircraft radios, and TV reception. Contrary to Machrone's implication, these are not

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CIRCLE 726 ON READER SERVICE CARD

Letters

regulated as a health-and-safety issue but as an interference problem.

Ed Mitchell
Woodinville, Washington

CHANGING STANDARDS

Who protects the innocent consumer when a manufacturer discontinues a product? I am sick and tired of purchasing equipment only to own it for a couple of years and discover that software drivers will no longer be available for it.

I own an Amdek 1280 and a Wyse 700 black-and-white, high-resolution monitor. Both *Microsoft Windows* and *WordPerfect* supported these displays in their earlier versions, but not in their new releases. These two monitors are not even "off-brand" names! There is no excuse for these not to be supported by either the software development companies or by the manufacturer.

Lisa Stovel
Livonia, Michigan

THANKS FOR THE MEMORY

I just wanted to express my thanks to Barry Simon and the staff for the excellent series of articles in the Lab Notes section regarding memory usage. Mr. Simon's article in the May 29, 1990, issue titled "How to Get the Most from Your System's High DOS Memory" was a godsend.

After experiencing assorted problems among my memory, my 8514 adapter, my VGA adapter, and a VCPI-compatible memory manager, I was delighted that reading the article solved my problem by showing me how to reconfigure my VGA card to 8-bit ROM and exclude the A through D regions from use by any 16-bit applications.

Ed Ranney
Hacienda Heights, California

A FORGOTTEN WORD PROCESSOR

John C. Dvorak states in his column (July 1990) that "Borland has . . . the potential to create a good word processor." At first I thought it was just an oblique put-down of Borland's *Sprint* word processor. Then I recalled that I have seen no mention in *PC Magazine* of that product.

Sprint is a superb word processor. Its documentation, in three volumes, is fully up to Borland's high standards. As a programmer, I particularly appreciate the inclusion of full source code for several user interfaces and for the file format.

Byron E. Blanchard
Lexington, Massachusetts

We covered *Sprint* in a First Looks article back on September 13, 1988.—*Ed.*

COMPUTER TALK

The reason voice-recognition technology hasn't made the keyboard a museum piece is not (as William F. Zachmann said in his June 26, 1990, column) its current inability to recognize "true continuous speech." It's the price tag.

Contrary to what Zachmann said, a system that recognizes a modicum of discreet words spoken by a specific individual would be fine for the average PC user. No matter how discreetly and choppy one needs to say "rubber baby buggy bumpers," it's still faster than typing it. And selections such as "slash file retrieve" or "Shift F7" could be done without lifting a finger.

Besides, who wants a PC that can understand everyday conversation, anyway? The pesky thing might overhear a nasty tidbit of gossip, document it, and then spill it all over the network.

Curtis Hoke
Reading, Pennsylvania

LOOK WHO'S SLOPPY

After reading John C. Dvorak's June 12, 1990, column, "The Software Slop Factor," I had to respond.

Now let me get this straight. For years, *PC Magazine* software reviews have given or taken points based on the utility embodied in the features of a given program. Developers, recognizing the prestige associated with a favorable review from *PC Magazine*, strive to enhance their products.

Then John Dvorak proclaims their code "bloated" and "slop." What are you guys, nuts?

Phil Pistone
Chicago, Illinois

BAN THE RICH

I am a longtime subscriber to your magazine and a great fan. I do, however, have some mild criticism to level at you, in the form of two suggestions. Ban the words *rich* and *suite* from your magazine. With the possible exception of the word *the*, these two words appear to be the most common words in *PC Magazine*'s ver-

THE RIGHT DECISION

PC MAGAZINE
HONORABLE MENTION
SEPT 11, 1990
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The 486 Champ

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PC MAGAZINE - SEPTEMBER 11, 1990

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PC MAGAZINE - July, 1990

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INFOWORLD - MAY 7, 1990

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DATA 486ec-25
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4MB RAM
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Full 80486 25 Mhz performance with a new low price!
WEITEK' 4167 support for even faster number crunching. With up to 8MB RAM on board (16MB total capacity), and a wide selection of superfast disk drives and video components, the DATA486-25 is geared to satisfy the most demanding power users.

Portacomp III 386-25
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For the power user, take along the new PORTACOMP III. This 80386-25 lunchbox portable with its VGA gas plasma display, full function keyboard and two full-size expansion slots makes an ideal remote base.

- VGA gas plasma display (640 × 480) with 16 gray scales
- 80386-25 processor
- 1MB RAM standard, expandable to 8MB
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- 40MB, 25ms Conner IDE hard drive (80MB, 100MB, 200MB drives optional)
- 1 parallel and 2 serial ports
- 101-key keyboard with separate numeric and cursor keys
- 150W power supply (110/220V autoswitching)
- 2 full-length 16-bit ISA slots
- Carrying case

(SX also available)

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PC MAGAZINE

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Why buy a laptop computer if you can't carry it with you? You wouldn't buy a portable radio without a battery, so why settle for a portable computer without the most essential element of portability. And why sacrifice the honest-to-goodness 32-bit speed of a genuine 386 (as opposed to the 32-bit emulation employed by an SX machine). Now you don't have to! DATAWORLD introduces a bona fide 20Mhz 386 laptop with the battery built right in.

In addition to all of the standard features offered by the competition, the LP320 has an LCD/VGA screen, which offers a high contrast normal or reverse video display. Also, an advanced sleep mode feature prolongs the usable battery time per charge by letting the display, hard drive, and CPU hibernate when not active. That's better by far than the competition's touted perfect portable!

Now, at a price far lower than SX's with a battery; indeed, priced in the same range as battery-less SX laptops, you can own a real 386 (20Mhz) portable complete with battery. With DATAWORLD, you don't need to sacrifice speed requirements to get portability or affordability. Look around if you like, there just isn't anything to compete with this value.

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DATA386-25 MAY 30, 1989

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PC MAGAZINE EDITORS' CHOICE
PORTACOMP II OCT 11, 1988

DATA LP/320 laptop

- VGA backlit LCD display, 640×480 resolution with 16 shades of gray. Built-in VGA port supports external VGA monitor
- 80386-20, processor, 80387 coprocessor support
- 1MB base RAM, expandable to 8MB on board
- 3.5" 1.44MB floppy drive (5.25" 1.2MB external drive optional)
- 43MB, 25ms IDE drive (80MB drive optional)
- 1 parallel and 2 serial ports; 1 half-length expansion
- [illegible] able battery with battery-level indicator light

VGA monitor (optional)

Mouse (optional)

Numeric 10-key pad (standard)

AC adapter (standard)

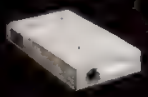
Modems/Network Cards (optional)

Intel or IIT Math coprocessors (optioal)

User Manual and FASTLYNX (standard)

External 5.25" floppy drive (optional)

Carrying bag (standard)



External tape backup drive (optional)

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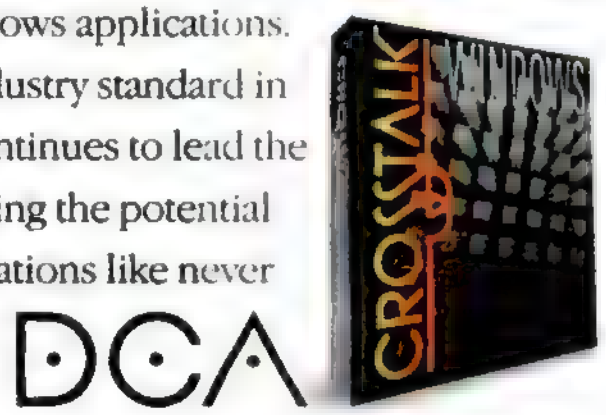

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nacular. It's been probably well on to three or four years since you've reviewed a software package that wasn't rich. Rich in features, rich in functionality, rich in GUIness, rich in its use of the keyboard. If any of you are using *WordPerfect*, perhaps you may want to take advantage of one of its . . . numerous features, specifically, the thesaurus. You can probably come up with another adjective as, um, useful as *rich* is.

Secondly, what happened to *group?* When did *suite* become *group?* I can see it now ... "Highly paid IBM copyright lawyers, dressed in a rich suite of suits, announced last week a rich suite of suits...." Gee, guys, every now and then is okay, but variety is the spice of life.

Thomas J. Love, Jr.
Hartford, Connecticut

THE REAL EDITOR'S CHOICE

While we are obviously pleased that you mentioned *PC Magazine*'s standardization on our products, *Collage Plus* and *Collage PM*, for in-house use, ("The Ultimate Utility Shelf," June 26, 1990) we were confused by the contradiction that the real editor's choice was not the "Editor's Choice."

Lynne Simonfry
Director of Marketing
Inner Media
Hollis, New Hampshire

PC Magazine has specialized graphics needs and Inner Media's *Collage* fulfills those needs perfectly. The other programs (*Hot Shot Graphics* and *Pizazz Plus*) qualify as more-multipurpose tools, hence a better Editor's Choice for noneditors.—*Ed.*

MISSING DATABASE

I was dismayed that you didn't mention Expressware's *File Express* in your June 26, 1990, article "Flat-File Databases: Fast Answers to Easy Questions."

I have used *File Express* for two years and have compared it with *PC-File* 5.0, *Q&A, Reflex, Professional File,* and practically every other database around. I continue to return to *File Express* and find it far easier and more intuitive to use than any other database around.

Peter H. Simpson
Jamestown, Rhode Island

To find out more about *File Express*, contact Expressware at P.O. Box 1800, Duvall, WA 98019; (206) 788-0932, for orders only (800) 753-FILE.—*Ed.*

COPY-PROTECTION NIGHTMARE

I'd like to comment on John C. Dvorak's article on copy protection (May 15, 1990). If vendors wish to use copy-protection schemes on their software, that is their choice. However, they should be required by law to list the type of copy protection on the outside of the package. That way the consumer can make an educated choice if he wants to buy the software or not. If I had known that certain software required the use of a key disk or a code from the manual, it would still be in the store. I found out too late: after I was home and the box was already opened.

George A. Kirkman
New York, New York

A HEADLINE ABOVE THE REST

I like the descriptive headlines for your columnists' articles. It's good to know what each columnist is writing about!

Michael Murray
Lenexa, Kansas

IF I ONLY HAD A HAMMER

John C. Dvorak writes in his June 26, 1990, column that certain super software products "get short shift"; if John is referring to summary and unsympathetic treatment, the word is "shrift."

In the same issue, Jim Seymour alludes to a reasonably well-known aphorism (though I don't recall having heard it before): "When you've got a hammer, everything starts to look like a nail."

Jim, I have a hammer. Not everything, however, looks like a nail to me, because I also have a screwdriver, a hacksaw, and a few other odd tools. Could it be that this gem of folk wisdom runs like this: "When *all* you have is a hammer . . ."?

N.W. Miller
Redlands, California

HOW TO WRITE TO PC MAGAZINE

Send letters to *PC Magazine*, One Park Avenue, New York, NY 10016, or upload to PC MagNet (see the "By Modem" sidebar in Utilities for access information). All letters become the property of *PC Magazine* and are subject to editing. ■

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"A little marvel!" —Jerry Pournelle, Infoworld (1/22/90)

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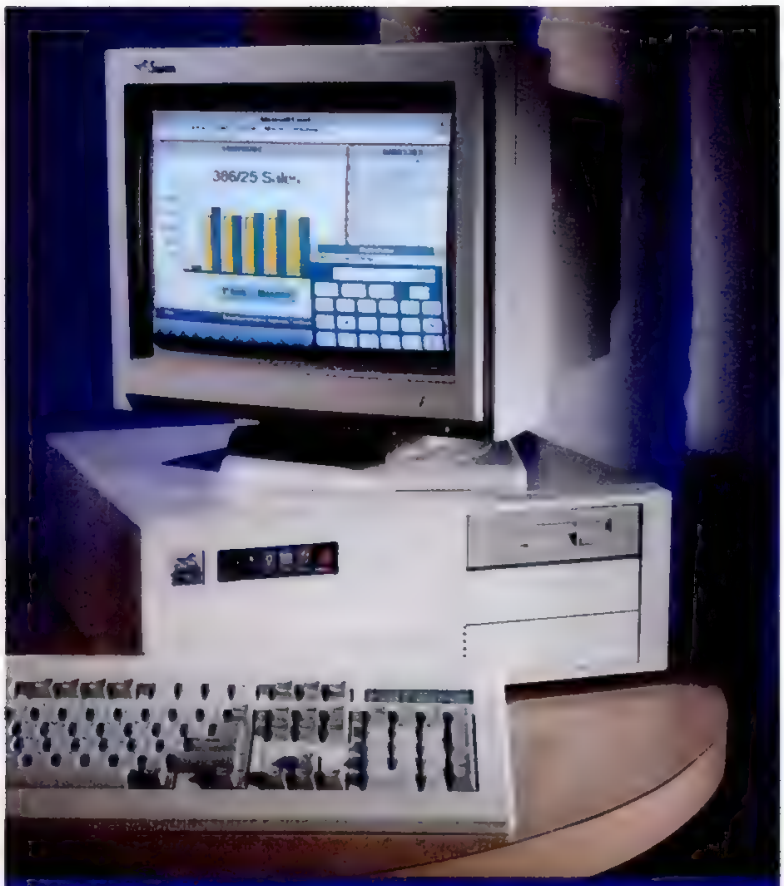

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PC Magazine, August 1989

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- 200 Watt power supply

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PRINTERS

Panasonic Office Automation

KX-P1124
The overall intelligence of this 24-pin narrow-carriage printer sets it apart from other printers in its class—at a very affordable price. PC Magazine Editor's Choice—11/89 (192 cps, 80 col, 24-pin). **$289**

1180 (192 cps, 80 col, 9-pin) $159
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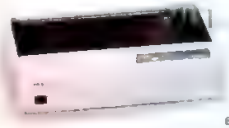

NX-1000II **$159** **star**

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NX-1000R (144 cps, 80 col, 9-pin) $199
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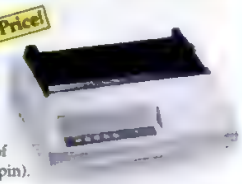

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KX-P4455 (11 ppm) $2199

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Okidata 800 (8 ppm) $1299
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Okidata 840 (Postscript printer) $Call

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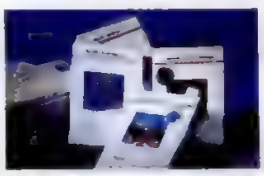

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by
Lori Grunin

Advisor

- KEYBOARD SWAP: Using a PS/2 keyboard with an AT compatible.
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KEYBOARD SWAP

I just sold an IBM PS/2 Model 30 and purchased a new IBM compatible, but am not happy with two different keyboards. I would like to know if I can use my old IBM enhanced keyboard on an IBM compatible. My new computer has a standard AT connection (9 pin) for the keyboard but the newer PS/2s use a small connection to the CPU unit. I hope you can help me.

Ford Fay
Southbury, Connecticut

Although IBM ATs and compatibles and PS/2 systems all use the Intel 8042 keyboard controller chip inside their system units, they hook up differently to the CPU. AT-class systems use a 5-pin DIN connector while PS/2 systems use a 6-pin miniature DIN connector. The same signals are present in both connectors (the sixth pin on the PS/2 is reserved and unused by the 101-key keyboard). Since IBM designed the keyboard so that the cable can detach from both the system unit as well as the keyboard, all you would need to hook up the enhanced 101-key keyboard to an AT or compatible unit is the appropriate cable, IBM part number 6447051 ($42.75; contact your nearest authorized IBM dealer for pricing information (800) IBM–2468).

Be forewarned that not all 8042s are the same and some clones may have different timing requirements or may interpret keyboard scan codes differently from the way the IBM 8042 does. This may lead to improperly translated characters, wild typematic (repeat) rates or in rare instances, total keyboard lockup.

SHARING CD-ROMS

One of the machines in the emergency room at the hospital where I work runs "Poisindex," a CD-ROM-based program that contains acute poisoning intervention information. In order to prevent loss of the actual disk, the CD-ROM drive is in a locked cabinet, inaccessible to daily users of the machine. Updates of the disk come quarterly, and the cabinet is unlocked to exchange the disks.

But in the past year several potentially useful CD-ROM disks have emerged that would be wonderful to have available, so we are now looking for a way to run them on this PC, yet keep the disks inaccessible. Having nonfriendly users change disks to access another program will assure that they'll disappear in no time. Are there multiple-CD disk drives on the market? If so, do they require any special hardware or software?

Christopher J. Heberer
Clawson, Michigan

Since your CD-ROM drive has a SCSI interface you can just connect additional CD-ROM drives to this same PC. However, only one person at a time would be able to access them. Since there are several solutions for networking multiple CD-ROM drives, one alternative is to set up a network connecting your five PCs. This way, you could keep your network server, with all the sensitive software, and CD server, containing your CD-ROM drives, in a secure area, while still allowing everyone to access the data. And provided you have obtained the proper licensing, you would also be able to have more than one person accessing the CDs at the same time.

Since you do not have a network installed, the least expensive way to create this setup would be to daisy-chain multiple CD-ROMs with SCSI interfaces (most CD-ROM drives use the SCSI interface) to one PC that would act as your CD server. Then, run Artisoft's *LANtastic* network which includes built-in CD-ROM support. For $525, the starter kit includes two adapter cards, cables, and a two-user version of the *LANtastic* software. (Artisoft, 575 E. River Rd., Tuscon, AZ 85704; (602) 293-6363. Last reviewed in "Making Do with DOS," in the May 29, 1990, issue of *PC Magazine*.) This software can use Microsoft's CD-ROM extensions, which run on the server. Each CD-ROM device is assigned a drive letter by which users at any station on your network could access them.

LET'S START AT THE VERY BEGINNING...

How in the world does one go out to buy a computer, when the only thing one knows about a computer is to look for the switch that turns the machine on?

I have been to various computer stores, but they ask "What will you be doing with the computer?" How do I know, when I don't know what it will do, or what I can do with it!

Dawn Wilk
Oak Forest, Illinois

Many would-be computer users find themselves facing this sort of "Catch-22" situation. Talking to others who have made a similar decision is often helpful. Fortunately, there are PC user groups in most areas of the country. Some members are technically strong and have been using personal computers for some time while others are beginners.

While the formats vary, typical meetings that I've attended consisted of a general question-and-answer session as well as presentations by hardware and software vendors. For those members with specific interests, many user groups support special interest groups (SIGs) specializing on one specific topic such as *Lotus 1-2-3* or *dBASE*.

Some user groups provide beginners seminars for their members in such topics as DOS, system setup, and hard disk management. These seminars are usually taught by volunteers and cost as little as $25 to $50 for a full-day class.

Finding a user group may not be easy. Computer stores and public libraries generally know of groups that meet near their locations. If a local newspaper has an editor who deals with computer-related stories, that person may know of local user groups as well. In your area, you can contact the Chicago Area Computer Hobbyist Exchange (CACHE) at (312) 525-5751.

FREE BUT COPYRIGHTED

Thanks for mentioning *I-APL* in your June 12th column. Please note, however, that *I-APL* is *not* in the public domain. I-APL Ltd. retains copyright to prevent modifications. Copying is permitted at no charge on the condition that the entire package is copied as it came from us.

Edward Cherlin
Co-Chairman, I-APL Ltd.
Weed, California

Thanks for setting me straight about the status of I-APL and for the additional information. I'm going to take this opportunity to point out the distinctions among public domain, shareware, commercial, etc. software.

Everyone recognizes commercial software, the most restrictive of the bunch. The disks usually come in a sealed envelope with lots of tiny print on it that states, with some variation across vendors, that only one person can use it at a time and can't copy it for all and sundry.

Shareware is also "commercial" software—although it's less expensive than the software that you'll see advertised by mail-order houses and retail stores, you still have to pay for it. But with shareware, you are free to copy it and try it out for an author-specified grace period. The registration and payment information usually appears in a READ.ME file on the disk.

People tend to confuse the last two—public domain software and freeware—because they're both free. The distinction between the two lies in copyright: when you get public domain software, you are at liberty to alter it, incorporate the code into programs of your own, and sell it. This is a distinct no-no with freeware, which is free but copyrighted, and follows the rules set out above by Mr. Cherlin.

ASK THE ADVISOR

Advisor is a collaborative effort of the PC Labs staff: Stuart R. Greenberg, Lori Grunin, Robert W. Kane, and Wendy Dugas Pérez contributed to this column. Send questions to Advisor, *PC Magazine*, One Park Ave., New York, NY 10016, or upload to PC MagNet (see page 8 for access information). Please specify your equipment. Unfortunately, personal replies are not possible. ■

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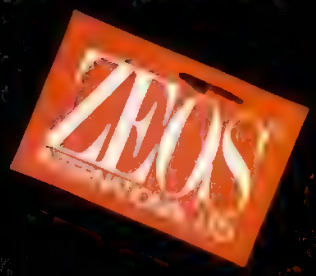

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CIRCLE 165 ON READER SERVICE CARD

First Looks

Hands-On Reviews of the Latest Products

A Stable, More Solid dBASE IV

HANDS ON
by Salvatore P. Ricciardi

dBASE IV 1.1 is what Ashton-Tate meant 1.0 to be all along. The update qualifies as one of the most widely anticipated bug-fix releases in PC history. But while 1.1 represents a more-dependable, tighter platform for Ashton-Tate devotees, the new release does little to address the advances made by competitors like Fox Software and Nantucket. *dBASE IV* 1.1 is a product that repairs the past but does little to address the future.

The major news with 1.1 is that the bugs in the 1.0 release are gone. Through an extensive beta test, massive internal testing, and a rewritten memory management system, 1.1 has emerged a more-stable product.

For example, in Version 1.0, a SQL query on a database that was more than 95 percent but less than 100 percent sorted could return incorrect results. In 1.1 this is fixed. Similarly, problems using PICTURE functions which required the use of NULL variable workarounds have been eliminated, and *dBASE IV* no longer locks up when you hit Ctrl-Break.

dMMS, the dynamic memory management system, was written from scratch to replace the memory management routines in 1.0. The new memory manager lowers *dBASE IV*'s memory requirements from about 520K to as little as 450K, allowing it to run in more LAN environments.

The new system is more flexible. Using 1.1's dBHEAP environment variable you can specify the percentage of available memory that *dBASE IV* uses for application space versus amount used for overlay swapping. When dBHEAP is set higher, more memory is available for complex applications. When set lower, more memory is available for swapping. Programs that use *dBASE* functions residing in overlays, such as those that define menus, pop-ups, and windows, run faster if more memory is available for swapping. Other environment variables, TMP and DBTMP, let you tell *dBASE* where to create and store temporary files. Using these variables to write to a RAM disk boosts performance.

Version 1.1 comes with an integrated disk cache called dBCACHE, a licensed version of HyperWare's *HyperDisk*. The cache can speed up disk performance by storing data in RAM; it can take advantage of either extended or expanded memory. Unfortunately, the only way *dBASE IV* makes use of expanded or extended memory is with the cache installed, unlike *FoxPro* which uses all available EMS automatically.

The cache is user-configured by setting options using the RUN command. Users should consider using the /W option, which tells the cache to write data to disk immediately. Otherwise, the cache defaults to Staged Write mode, which temporarily queues up data in memory before writing it to disk. The latter mode results in enhanced performance, but can result in lost data if the machine locks up or is turned off before the data gets written.

Several language enhancements, some recommended by Ashton-Tate's dLAB advisory board, are part of 1.1. For example, the KEYBOARD command can be used to stuff keystrokes into the keyboard buffer. REPLACE FROM AR-

CONTINUES ON PAGE 34

PC MAGAZINE OCTOBER 16 REVIEW INDEX

Norton Utilities 5.0
New features, new face, new headaches.....36

LetterPerfect
Smaller, gentler *WordPerfect*.....38

Thinx
Database with a graphical twist.....43

Two WP Utilities
Design templates and macros for *WordPerfect*.....46

Kappa
An expert system comes to *Windows*....50

HP's LaserJet IIID: Not Unexpected but Welcome, Especially at the Price

HANDS ON
by Alfred Poor

Hewlett-Packard shook up the market last winter when it aggressively priced its new LaserJet III at $300 less than its predecessor, the LaserJet II. Now the company has done it again with the release of its next-in-succession, the LaserJet IIID, which lists for $3,595.

This price represents a substantial reduction in cost compared with the $4,295 LaserJet IID it supersedes. The IIID lists for $700 less than the older IID printer—in effect, it's a new product that costs less than the old.

Don't think that HP took anything out to keep the cost down, however. The IIID has all the features you might expect in a IID replacement. There are a pair of 200-sheet paper trays, so you can put letterhead in one tray and blank pages in the other, using software commands to switch between the two. Or, if you are looking for a printer to hook up

CONTINUED ON PAGE 35

It's no surprise that the HP LaserJet IIID is similar to the III, but the new printer adds duplex printing.

First Looks

dBASE IV

CONTINUED FROM PAGE 33

RAY complements the existing COPY TO ARRAY command, making it easier to replace one or more records from the contents of an array. A WINDOW() function returns the name of the currently active window.

A new FOR clause is included in the INDEX command to allow the creation of INDEXES for .MDX files that only include records matching the FOR condition. This allows the creation of smaller INDEXES.

The MODIFY STRUCTURE command now works identically to the one in *dBASE III Plus*, in that it creates a backup of the database whose structure is being modified. You can also control the row and column placement of messages using the optional AT clause for the SET MESSAGE TO command, and a REQUIRED option can be used during data entry to specify that data should be validated all the time, whether it's been changed or not.

When viewing or editing database records using BROWSE or EDIT, a new Organize menu helps reorganize the information. The menu lets you create a new index, change an existing index, or use sort to reorder the records. You can also mark or unmark records for deletion.

dBASE IV 1.1 lets you work with indexes without leaving the BROWSE or EDIT screens.

In the "somewhat improved" category, memo fields are still limited in size to 64K, but now, memo windows honor the settings for STATUS and SCOREBOARD. Version 1.0 ignored these.

Other improvements include the removal of many previous restrictions on the use of user-defined functions, enhancements to the functionality available in SQL mode, and a more-flexible query design screen.

Users of the older 1.0 version will be pleased with the speed of the new 1.1; others may not be as enamored. In PC Labs benchmark tests, *dBASE IV* 1.1 performed significantly faster than 1.0 when dBCACHE was installed, even without setting any performance-tuning options. For example, in our sort test where database records are physically rearranged, *dBASE IV* 1.1, with the cache loaded, completed the test 29 percent faster than 1.0. Similarly, the Delete and Index test, which removes several fields (columns) from the test database and then creates an Index on one field, showed that *dBASE IV* 1.1 completes the test in 9 percent less time than 1.0. Overall, 1.1 with the cache loaded improved by approximately 34 percent over 1.0.

Still, even with these improvements, *dBASE IV* 1.1 is roughly two to three times slower on average than Fox Software's *FoxPro* 1.02. *FoxPro*'s SORT finishes in little more than a third of the time it takes *dBASE IV*, a significant difference if your application calls for a physical sort. In another test, which created an index on a 12-character field, *FoxPro* finished two and a half times faster than *dBASE IV* 1.1.

The improvements and stability of Version 1.1 are good news, especially to users of 1.0 who'll get a free upgrade. But, Ashton-Tate has not put anything in this new release that gives it the technological lead in the *dBASE* language arena. Nothing in *dBASE IV* 1.1 compares with the event-driven, multiwindow mouse-supported development environment in Fox Software's *FoxPro*. And *dBASE IV* cannot match *FoxPro*'s speed.

At a developers conference in September 1988, Ashton-Tate promised to produce the *dBASE* Professional Compiler, a product that would produce true .EXE files from *dBASE* language code and offer the extensibility and flexibility made popular by Nantucket's *Clipper* compiler. Two years later, the *dBASE* Professional Compiler still hasn't entered beta test.

With industry developments in object-oriented programming and event-driven environments and with companies like Fox Software, Nantucket, and Borland already hard at work embracing these technologies, it's worrisome that Ashton-Tate has not given any indication of moving *dBASE* into the next generation. *dBASE IV* 1.1 is a stabler *dBASE IV*, but technology marches on. ■

FACT FILE

***dBASE IV*, Version 1.1**
Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90509-9972; (213) 329-9989
List Price: Standard Edition, $795, Developers Edition, $1,295, LAN Pack for five users, $995.
Requires: DOS 2.1 or later, hard disk with at least 3.5MB free, 640K installed RAM with 450K available at runtime.
In Short: A faster, stabler version of *dBASE IV*. Includes an integrated disk cache and tuning options designed to enhance performance.

CIRCLE 882 ON READER SERVICE CARD

Number One But Trying Harder

Ashton-Tate's been through the worst of times and the ordeal is showing.

The *dBASE IV* 1.1 press conference stood out dramatically from every other PC software introduction in the past few years. There was humility in the air. There was talk of bug fixes and just the barest hint of an apology for past mistakes. But more than anything, there was a quiet determination to mend Ashton-Tate's tattered image.

The bugs in *dBASE IV* 1.0 and incompatibilities with earlier releases had done more than erode the company's market share: it put the firm into the red for the first time ever.

Computer Intelligence of La Jolla, California, tracks the buying habits of large corporations and found that for the most recent three-month period, *dBASE*'s total share of the database market for both *III Plus* and *IV* had slipped to 58 percent, down from 70 percent in May 1989.

The benefactors of Ashton-Tate's dilemma have been Borland's *Paradox* with 15 percent of the market; Fox Software's *FoxPro* with 8 percent, and Microrim's *R:BASE* with 6 percent.

Worse still, the total database market has been sluggish. Buyers have been hesitant to make a choice until a clear winner emerges.

Ashton-Tate recognizes that before the market can grow, it's got to regain the confidence it once had.

Developers who have stuck with *dBASE* through the worst of times find the company's new attitude refreshing and hopeful. Still, the people with the most to say about Ashton-Tate's future may be the programmers who left the company during the bad times: many are now working for the competition.—**Gus Venditto**

First Looks

LaserJet

CONTINUED FROM PAGE 33

to a network for long, unattended print jobs, you can tell the printer to switch automatically from one tray to the other when one empties. With the paper trays installed, the printer measures 32.5 by 18.3 by 13.8 inches—a trifle large for some home desktops, but well suited to the office environment.

The "D" in IID and IIID stands for "duplex" and refers to a nifty trick these printers manage—they print on one side of the paper, and before the page ejects, pull it back through a paper-handling path that flips the page over so that you can print on the other side. This paper-saving feature works just the same in the IIID as it did in the IID, with only a small penalty in print speed; in the PC Labs Printer Benchmark Text Speed test, the rate dropped from 7.6 pages per minute one-sided to 6.4 ppm to print on both sides.

Overall, print speeds are about what you'd expect for an 8-ppm-rated Canon engine—in this case, the LBP-SX. In fact, even though HP rates the two printers at identical speeds, we found that the tested IIID is slightly faster than our benchmark test results for the IID.

The advantage of the IIID over the IID isn't just a lower price or a little more speed, it is PCL 5 and Resolution Enhancement—the same features found in the LaserJet III.

PCL refers to the Printer Command Language used by HP printers, especially the laser printers. The latest version is PCL 5, which was first introduced in the LaserJet III. One of the most important features is the addition of scalable font technology based on AGFA Compugraphic's Intellifont technology. The printer comes with font outlines for CG Times and Univers in medium, bold, italic, and bold italic faces, which you can scale from .25 to 999.75 points. (72 points to the inch means you can print letters larger than a single sheet of paper.) And if you want more fonts, HP offers two sets of scalable fonts in cartridge format for $399 each.

There is more to the font tricks offered by PCL 5 than just size. You can print the fonts up, down, or sideways, all at the same time and on the same page—considerably more options than the limited portrait-only or landscape-only modes of the older generations of LaserJets.

PCL 5 adds support for HPGL/2, the new generation of the command language used by HP pen plotters. Text can be converted into vector-based plotter commands that can then be manipulated further, making it possible to print text at any angle, to fill text with patterns, and to print white letters on a black background.

Another advantage of the HPGL/2 support is that, in most cases, vector-based graphics can be transmitted from computer to printer far faster than bit images. So, you have the option to print charts from graphics programs much faster by configuring the output for an HP plotter instead of a LaserJet.

PCL 5 also speeds up bit-mapped graphics printing by using three different, situation-dependent modes of file compression, thus reducing the time it takes to transfer the image from the computer to the printer. This feature has not yet been widely supported by software applications.

The other half of the story is Resolution Enhancement. The LaserJet IIID, like the LaserJet III, prints with 300-dots-per-inch (dpi) resolution, and, in addition, it can also vary the size and placement of the dots. With five different dot sizes and three print positions per dot location, the printer engine is able to smooth the "jaggies" out of the curved and angled lines found in letters and line art. This technique yields a stunning improvement in output quality, quite visible to the naked eye. The effect is nearly equivalent to 600-dpi output.

All of these features and craftsmanship are packed into a printer that is rated for 20,000 pages per month. That works out to nearly two reams of paper every business day, which is a significant workload. HP recognizes that the IIID is destined for heavy-duty assignments in critical jobs, such as a shared network printer, so HP goes out of its way to back the printer's performance. The IIID is the only HP desktop laser printer to come standard with a one-year on-site warranty.

If this is not enough, there are plenty of options you can use to dress up your IIID as the situation demands. For example, HP offers an automatic envelope tray for $350, and a legal-sized paper tray for $79.

You can turn the IIID into a PostScript printer. All it takes is the $695 HP PostScript cartridge to add true Adobe PostScript to your printer. The cartridge requires additional memory, but it is user-installable and comes in 1MB or 2MB cartridges. The printer can hold up to 2 cards for a maximum of 4MB of upgrade memory.

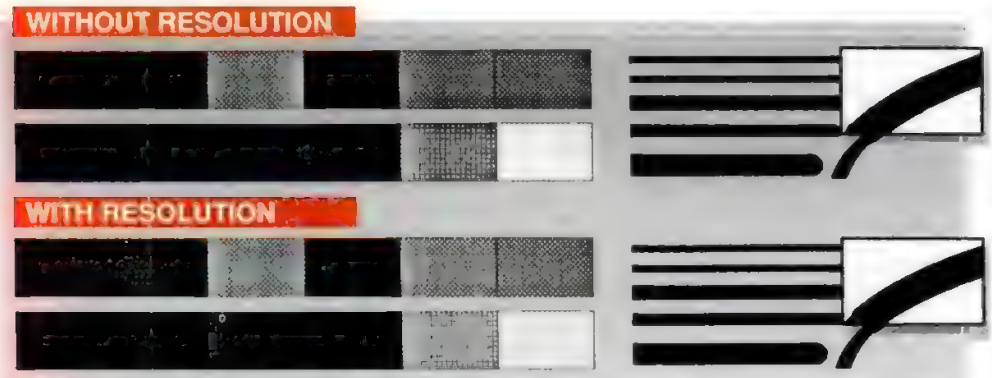
For single-sided printing, you'll need to add 2MB to the 1MB that comes standard with the printer. Duplex printing under PostScript requires a 4MB upgrade. Fortunately, HP has dropped prices on its memory upgrades, with the 1MB board priced at $335 (down from $495) and the 2MB at $560 (down from $740.) This brings the total price for a IIID with PostScript and support for duplex printing to a list price of $5,410, which is still competitive with other heavy-duty PostScript printers. (An AppleTalk interface is available for an additional $275.)

Predictably the LaserJet family has expanded again. You benefit by having another option for printing with PCL 5 and Resolution Enhancement technology. While the IIID is expensive for use as a personal printer, its rugged duty cycle and paper handling make it ideal for sharing among many users or in situations where there's a lot of printing to be done. ■

FACT FILE

HP LaserJet IIID
Hewlett-Packard Co. Inquiries, 19310 Pruneridge Ave., Cupertino, CA 95014; (800) 752-0900.
List Price: $3,595; 1MB memory expansion, $335; 2MB memory expansion, $560.
In Short: The LaserJet IIID offers a high-duty cycle, good performance, PCL 5 support, and outstanding print quality through Resolution Enhancement technology.

CIRCLE 652 ON READER SERVICE CARD



The HP LaserJet IIID's resolution enhancement technology makes 300 dpi printing look better than ever. The print samples were created without resolution enhancement (top) and with resolution enhancement (bottom). Notice how the jaggies are smoothed out of the curved line in the bottom sample.

Norton Utilities 5.0 Adds Features, Improves Interface
(But Don't Throw the Old One Out Yet)

HANDS ON
by Edward Mendelson

You'll have no trouble recognizing Peter Norton's face on the box, but you may rub your eyes in surprise at the software inside. *The Norton Utilities* 5.0, now published by Symantec at $179 (upgrade price $49), sports a gleaming mouse-and-menu interface, and impressive new power and features, including on-the-fly file encryption, virus protection, a disk cache, a low-level reformatter, and temporary deep storage for deleted files. Users accustomed to earlier Norton programs can avoid most menus with command-line shortcuts.

Norton's disk utilities now surpass anything you can find in *PC Tools Deluxe* or *The Mace Utilities*, and offer safeguards you can't find anywhere else. Still, you might be wise to hold onto Version 4.5 until some of the bugs and rough edges disappear from 5.0. The README file even suggests that you retain some of the smaller programs from 4.5 if your batch files expect them or your fingers are accustomed to running them from the command line.

You'll be relieved to learn that the new version of the Norton Disk Doctor is faster and more expert at repairing trashed FATs and directories, works smoothly with high-tech drives and third-party partition software, and provides full control over testing and recovery. The package includes an emergency first-aid card and a detailed guide to manual repairs in the event your disk is too badly trashed for completely automated repairs.

Manual repairs are easier than ever with Norton's sleek new disk editor, which has more intelligence than any other—including its ancestor, the classic but often awkward, NU. The new disk editor lets you split the screen into two windows so you can work on a FAT or directory in one window while editing files in another. It even allows cut-and-paste operations, and lets you jump between directories and files simply by pressing Enter. For safety, you can make the program read-only; for power, you can hex edit files on networks. A separate file fixer offers smart repairs of *dBASE* and *Lotus 1-2-3* files.

The old Quick Unerase program is now a flexible toolkit that allows either automatic recovery or painstaking reconstruction. You can still recover deleted files from the DOS command line, but now the program can also take you directly to the manual unerase features that used to be part of NU. An optional TSR preserves specified deleted files in a special directory for a set number of days—guaranteeing recovery, even after defragmenting the disk.

A new security program creates files seen by DOS as phantom drives, and encrypts any files that you write to those drives. The new disk cache is quick, compact, and intelligent, and can load most of itself into high memory even if you don't use a memory manager. With *QEMM-386* or *386MAX*, you can load the cache and all other Norton TSRs into high memory—an essential way of economizing RAM not provided by *PC Tools*.

Norton's disk tests have been enhanced by a low-level reformatter and tester that's cleaner and more flexible than *SpinRite II*. It can test ESDI and SCSI drives, although it's smart enough not to try to mess with their low-level format or interleave settings.

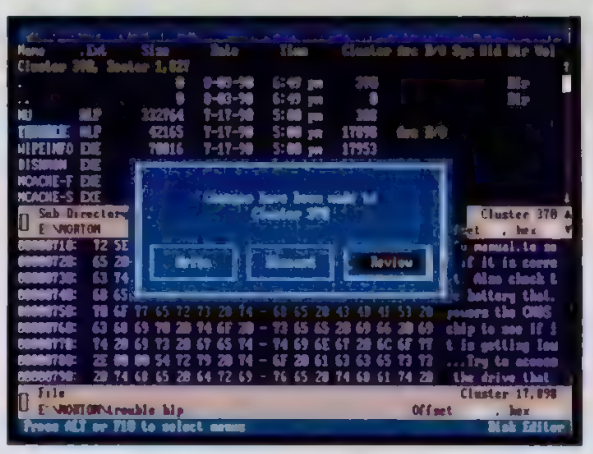
The old SysInfo (system reporter and benchmark program) is now a multiscreen survey with (at last) useful benchmark tests that tell you how your computer performs instead of just flattering it.

The old text-search program is folded into the file finder, which now saves you the trouble of looking at all the search "hits" in one file when you know you want to jump to the next file. Norton's FileFind is the first commercial program to let you search multiple drives, but doesn't include an option to search all hard drives only. Norton promises a fix in the next version.

With the added features, *Norton* 5.0 feels more like a new program than an upgrade. Like most new programs it has its share of rough edges. The directory sorter, now folded into the defragmenter, no longer divides a directory list into an alphabetized list of subdirectories followed by an alphabetized list of files—and sometimes it gets confused and doesn't fully alphabetize the list. The program menu that saves deleted files sometimes leave bits of previous menus over the current one. Some of the error messages in the cache tell you to contact something called IDC—presumably the firm that developed the cache program for Norton.

SysInfo reports that you have an IBM AT even when it knows that you have a non-IBM BIOS and a 386. SysInfo's benchmark tests reported that a fast hard disk had a transfer rate of 0Kb per second—apparently because it gets confused by rates higher than 999. The disk editor lets you display ordinary files as if they were directories, which can frighten you into thinking that your directories are scrambled. Also, when you specify the path and file you want to edit from the command line you'll have to enter the path in uppercase letters—an absurd bug that should never have escaped beta testing.

All these are cosmetic flaws in a uniquely powerful package. You need the new *Norton*—but until its edges are smoother, keep the old one too. ■



The Disk Editor in the *Norton Utilities* 5.0 allows split-screen editing with a cut-and-paste function. Pressing the Enter key from the directory or FAT viewer immediately opens the associated file.

FACT FILE

***The Norton Utilities* 5.0**
Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; (408) 253-4092.
List Price: $179; upgrade from Version 4.5, $49.
Requires: DOS 2.0 or later, 512K RAM.
In Short: Norton's latest has the most powerful and flexible group of disk utilities in existence, including new speed and security functions, but this essentially new package still shows some cosmetic rough edges.

CIRCLE 646 ON READER SERVICE CARD

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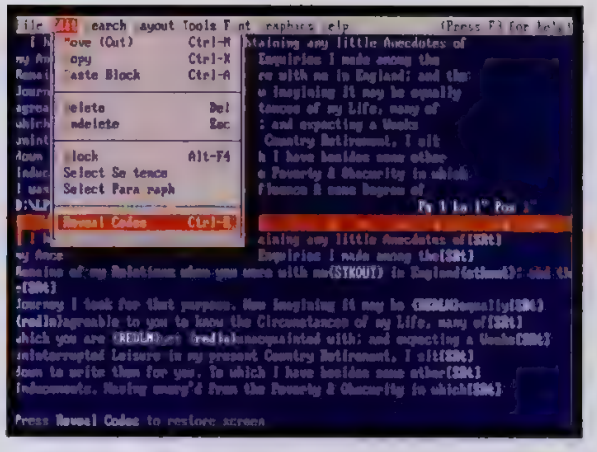
CIRCLE 299 ON READER SERVICE CARD

LetterPerfect: A Less-Intimidating WordPerfect 5.1

HANDS ON
by Rob Kendall

WordPerfect Corp. climbed to the top of the high-end word processing world, but, try as it might, it has never been able to gain a sure footing in the low-end market. *WordPerfect Junior* and *Personal WordPerfect*, scaled-down versions of *WordPerfect* 4.1 and 4.2 respectively, never caught on. Casual users found the stark interfaces intimidating. *WordPerfect* devotees looking for a laptop alternative balked when these products failed to maintain compatibility with the newer, Version 5.0. *LetterPerfect*, which is *WordPerfect* 5.1 compatible, solves both these problems and comes up a winner.

5.0 compatible, this $229 program is also aimed at the users that *WordPerfect* 5.1 left behind with its stringent hardware requirements. Unlike its older sibling, *LetterPerfect* runs on anything from two 360K floppy drives (with some disk swapping) and is happy running with less than 640K RAM. A minimal installation with spell-checker, thesaurus, and printer drivers consumes just under a megabyte of hard disk space. It makes much less use of overlays than the full-bodied *WordPerfect*, and so makes fewer disk accesses, saving time and—on a laptop—battery power.



LetterPerfect's pull-down menus are simpler than WordPerfect's and make use of drop shadows. WordPerfect codes not supported by LetterPerfect appear in the Reveal Codes window in braces.

To assume its capsuled form, *LetterPerfect* jettisons the most-specialized features of *WordPerfect* 5.1. Gone are math and equation editing, automatic indexes and tables of contents, columns and tables, red-lining and footnotes (though you still have endnotes). Styles and nonprinting comments are gone, as well.

Other features that make *WordPerfect* powerful remain in a less-potent form. The same encyclopedic printer support exists but the drivers included don't support soft fonts. With enough disk space you can substitute the *WordPerfect* drivers; WordPerfect will supply these drivers for a nominal fee. Some print attributes are missing, such as small caps, but you can still select any typeface or size from the base font menu. The mix/match approach carries over to the spell-checker and thesaurus. Again, registered *WordPerfect* users can substitute the more-complete files from the parent program.

WYSIWYG print preview remains fully intact, and you can still add graphics to documents. You lose some options, though, such as attaching captions or altering the images. You can bring in all the file formats supported directly by *WordPerfect*, but only after converting them with a separate utility. The program also retains its mouse and network support.

Taking *LetterPerfect* on the road but sticking with *WordPerfect* 5.1 at home should be simple. We had no trouble passing a document back and forth between the two programs numerous times, making changes each time. Codes for *WordPerfect* features that *LetterPerfect* doesn't support appear in the Reveal Codes window, surrounded by braces. Tables and columns appear as regularly formatted text; footnotes show up as endnotes. Edit the text within unsupported codes and it will reformat correctly once back home in *WordPerfect*.

Added features make *LetterPerfect* more than a stripped-down *WordPerfect*. You get mnemonic speed keys, such as Ctrl-B for boldface. The help index lets you perform any listed function when selected, thus doubling as an alphabetized menu to complement the pull-down menus. Move and Copy functions prompt the user, and context-sensitive help is easily available. Laptop users can select screen-color settings optimized for LCD or gas plasma displays, and the print preview has an invert-colors option to make viewing easier on some laptop screens.

You also get *WordPerfect* Shell, which switches among concurrently loaded applications, swapping files to EMS or disk as needed. However, *LetterPerfect* relies on Shell for features that should have been left in the word processor itself: the only way to switch between two documents for cutting and pasting is to load two copies of *LetterPerfect* from Shell and use the Shell clipboard.

LetterPerfect competes well with other low-end products—especially its graphic capabilities and font handling. The two-way file compatibility with *WordPerfect* 5.1 is just icing on the cake. ■

FACT FILE

LetterPerfect
WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; (801) 225-5000.
List Price: $229.
Requires: 384K RAM, DOS 2.0 or later.
In Short: A solid, easier-to-use, low-end alternative to *WordPerfect* 5.1 that offers file compatibility with its parent program. It retains *WordPerfect*'s print preview and extensive printer support.

CIRCLE 432 ON READER SERVICE CARD

WHAT RHYMES WITH WORDPERFECT?

A less mainstream writer's tool making its debut is *WordPerfect Rhymer*, a TSR rhyming dictionary that functions like a pop-up thesaurus. Traditionally a tool for poets and lyricists, a rhyming dictionary can also serve any wordsmith looking for that occasional musical turn of phrase.

Rhymer offers a larger dictionary (90,000 words) than competitors like *The Poet's Companion*. It also provides an impressive range of look-up options, including multisyllabic rhymes and alliteration.

A search can be limited to words of a specified number of letters or syllables. A phonetic search option provides wildcards to match words by sound pattern. The only serious flaw in the package is that you can't scroll backward through the words it finds. All in all, *Rhymer* is an exceptional example of its genre.—**RK**

List Price: *WordPerfect Rhymer*, $79. **Requires**: 79K RAM, DOS 2.0 or later. WordPerfect Corp., 1555 N. Technology Way, Orem, UT 84057; (801) 225-5000.

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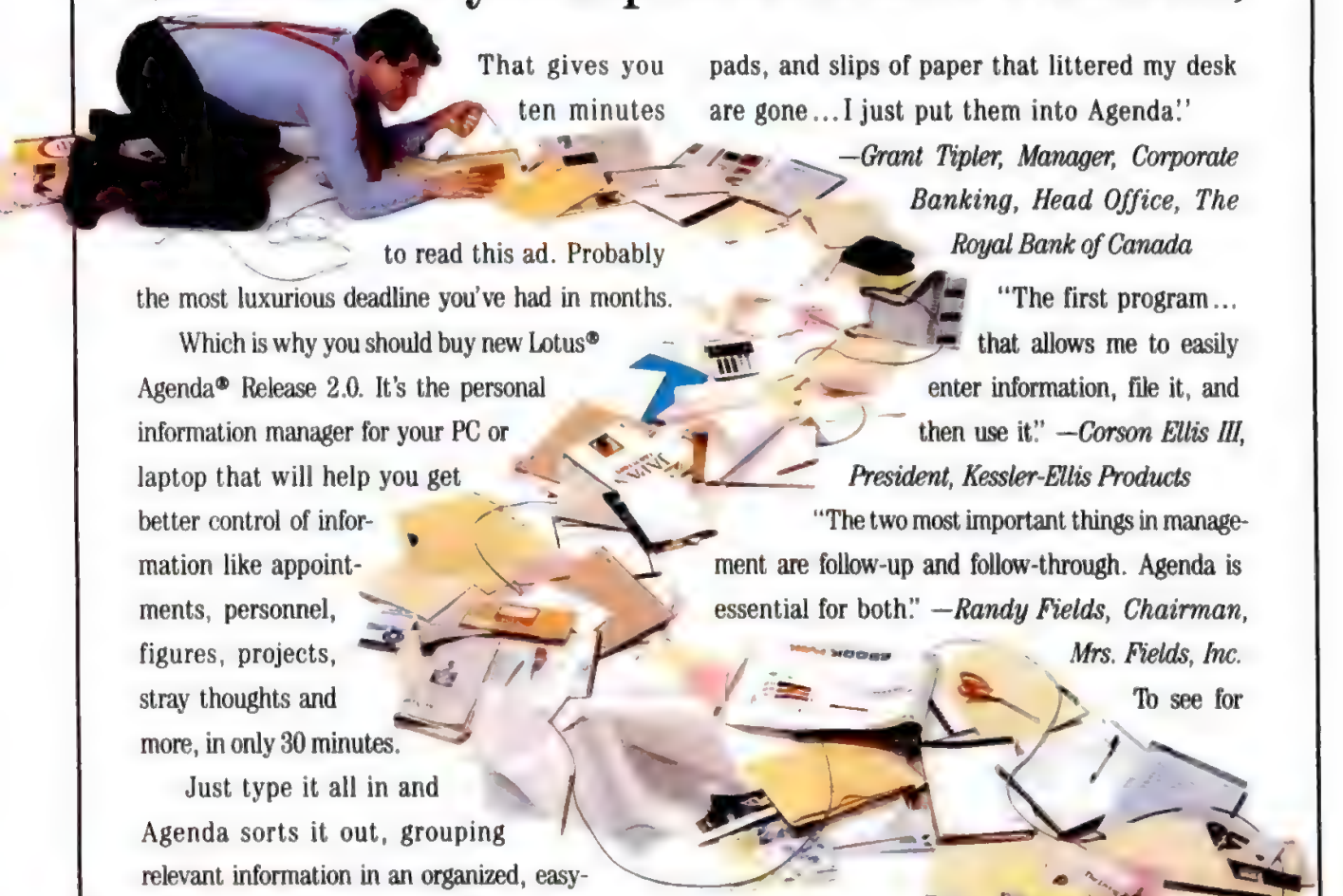

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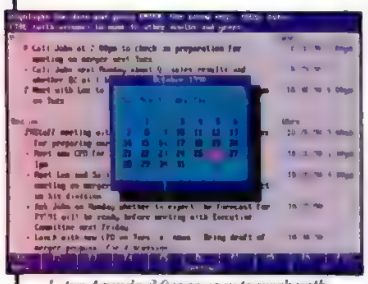

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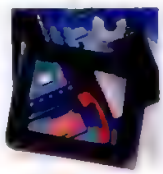

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- 16-bit VGA card w/512K
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- Super VGA color monitor (1024x768)
- 2 serial, 1 parallel & 1 game ports
- 101 Enhanced keyboard
- MS-DOS 3.3 or 4.01
- Two year warranty*

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- 16-bit VGA card w/512K
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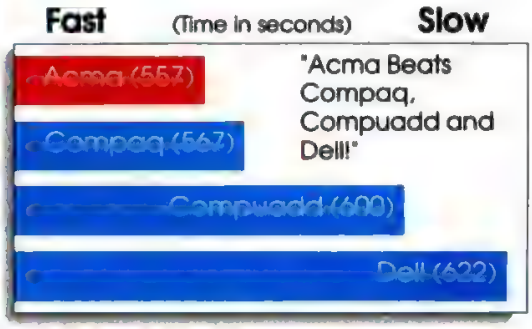

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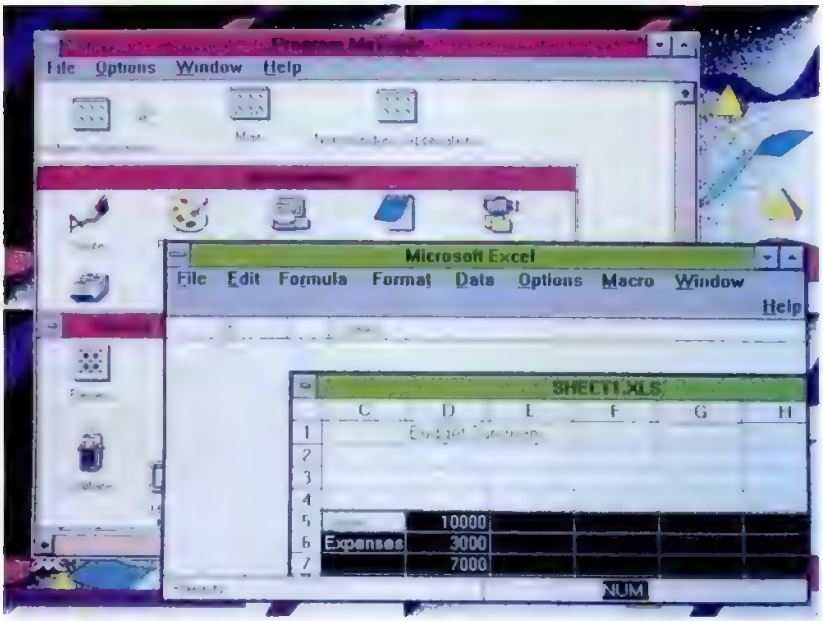

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Seiko Instruments

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CIRCLE 490 ON READER SERVICE CARD

Thinx Sketches Your Data

HANDS ON
by Jeff Prosise

What would a database manager look like if you threw out everything you knew about database management systems, threw in *Windows* 3.0, and started from scratch? That's what a group of programmers at Bell Atlantic did to come up with *Thinx*, a database that is radically different. Rather than store information in tersely defined records and fields, *Thinx* attaches data directly to graphic images. These images, and their data, form objects that can be manipulated on-screen or operated on with spreadsheet-like formulas.

Imagine creating an organization chart where clicking on an individual's name opened a window containing data about that person, with name icons color-coded to reflect years of service. Imagine a kiosk where a customer could assemble a PC from a menu of on-screen components, and interactively tally the price during assembly. Because *Thinx* lets you establish links between objects and data, activities that transcend the conventional means of organizing information are possible.

A *Thinx* database consists of one or more sets of symbols (graphic images) which have data or formulas associated with them. Once data is associated with a symbol it forms an object. Data associated with a class of objects is grouped together in a table which can be browsed or modified, or operated on by a formula. This formula can also be attached to a symbol in the workspace.

You can put as many different objects and classes of objects in a file as the workspace will hold. To help you work around the physical limitations imposed by the size of the display screen, *Thinx* offers an assortment of zoom commands.

The weakest step in the *Thinx* process is creating the graphic images. *Thinx* supplies a set of built-in vector-oriented drawing tools that is similar but less robust to those found in dedicated drawing packages. You can also import images via the *Windows* clipboard or with *Thinx*'s Import command (Micrografx .DRW files only). The version we used crashed a few times, displaying an internal application error when we imported large .DRW files.

Once an image is created, you can replicate it and attach attributes to it to form objects. Attributes are entered like fields in a database. *Thinx* supports character, numeric, date, time, and logical attribute types.

Data for entire ranges of objects may be viewed in tables. A search option can filter the objects represented in these tables by setting up search criteria. You can even have *Thinx* change the way objects are displayed based on their attributes. You could, for example, highlight everyone with more than 10 years company service in red on an organization chart.

Or, you may elect to attach a formula to an object. Formulas can operate on data associated with other objects. *Thinx* provides 23 different functions for inclusion in your formulas. *Thinx* can also swap information with other programs, notably *dBASE*, *Microsoft Excel* (via DDE), and *Lotus 1-2-3*.

Thinx has its share of shortcomings. The drawing tools are not powerful enough to create much more than primitive line drawings. *Thinx* could use a programming language, or a least a rudimentary macro language to help automate repetitive tasks. Despite these problems, *Thinx* is the forerunner of a whole new genre of database managers that work the way *you* think. ■

FACT FILE

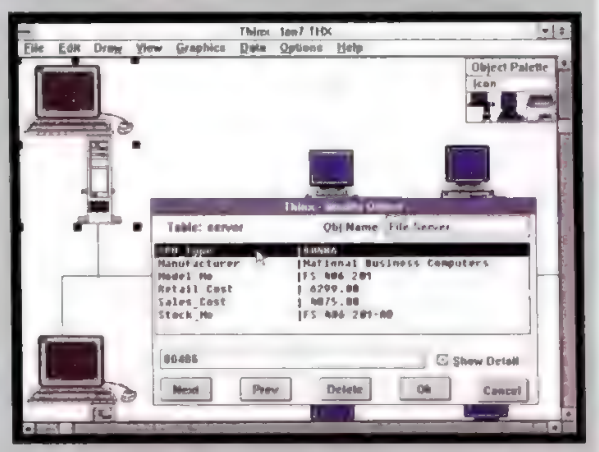
***Thinx*, Version 1.0**
Bell Atlantic, 9 S. High St., Morgantown, WV 26505; (800) 688-4469.
List Price: $495.
Requires: 640K RAM, DOS 3.1 or later, *Windows* 3.0.
In Short: A graphical, object-oriented database manager for *Windows* 3.0. *Thinx* attaches data directly to graphical objects which can be manipulated on-screen or operated on with spreadsheet-like formulas.

CIRCLE 680 ON READER SERVICE CARD

INTELLIGENT GRAPHICS

This network configuration illustration was created with Micrografx clip art. Each component is stored on the Object Palette. Each object has a number of attributes including manufacturer and cost. The red oval shows the cost of objects in the work area; it is associated with three SUM functions, one for each object. Like a spreadsheet, *Thinx* has automatic recalc so that the cost is updated each time a new object is moved into the active area.

Double-clicking on an object pops up this dialog box for entering and editing data. You structure the database by defining objects and object attributes and then assigning them values. In this case, the box shows the data behind the file server icon. Data for all objects can be viewed in table form; a search button lets you filter what's displayed in the table by setting up search criteria.—JP



Mewel Brings Microsoft Windows API To Character Mode

HANDS ON
by Salvatore P. Ricc

Taking advantage of the *Microsoft Windows* user interface and programming model means using graphics, *Windows* memory management, and multitasking. What if you don't need these features or don't have the platform to run them, but still want a *Windows*-like interface?

Mewel is a character-mode implementation of the *Windows* programming model. With *Mewel*, you can create applications that employ a similar, character-mode subset of the *Windows* API.

Mewel (Magma Extensible Window and Event Library) uses the same terminology as *Windows*, such as function and message names, and employs a similar message-passing architecture. If you've been programming *Windows*, you'll adapt quickly. If not, *Mewel* can be an entry point into the event-driven message-passing model.

A *Mewel* program uses windows and window procedures just like in *Microsoft Windows*. Because *Mewel* is character-based, porting an application between *Windows* and *Mewel* requires modifications. For example, function parameters are not always the same, and many *Windows* functions do not have *Mewel* equivalents.

Mewel also provides many features useful in building CUA- (Common User Access) compliant applications. It supports the mouse, multiple overlapping windows, dialog boxes, control windows, and drop-down menus and has support for window subclassing and external resource files. Most of the controls supported in *Windows*, including scroll bars, check boxes, radio buttons, push buttons, list boxes, edit fields, static controls, and the combo-box control, are available.

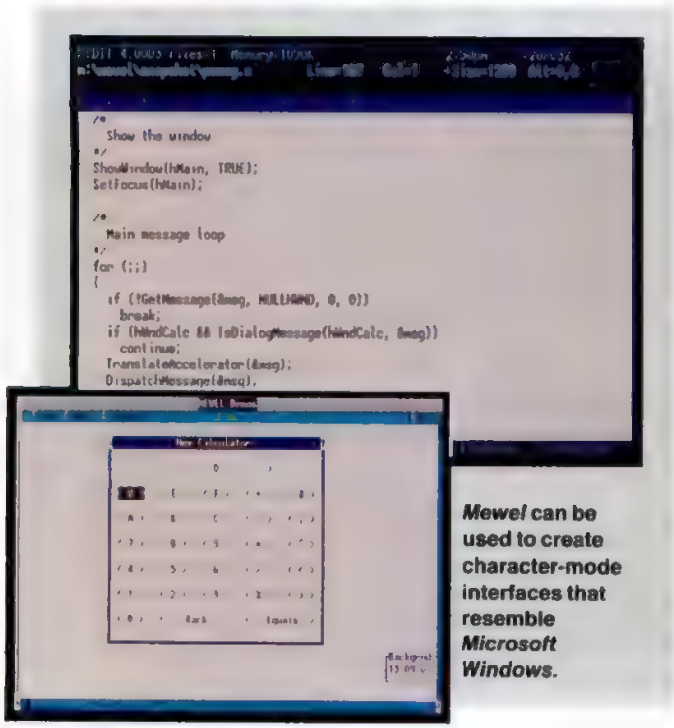
Emulating *Windows* can have drawbacks. *Mewel* lacks some of the same things that *Windows* lacks, such as formatted data entry. *Mewel* has no built-in support for integral data types such as dates, social security numbers or telephone numbers, although an implementation of *dBASE*-like formatted edit-fields is available on Magma's BBS.

The documentation needs improvement and professional typesetting. The index only includes function and message names; the reference section is difficult to read. A chapter on converting between *Microsoft Windows* and *Mewel* is absent.

For $195, the base package includes medium and large model library support for Microsoft C, Version 5.1 and later, as well as Borland's Turbo C, Version 2.0 and later. A $495 version includes complete source code, written in C with some assembler, and makes files to rebuild the system. ■

List Price: *Mewel*, Version 3.1, $195; $495 with source code. **Requires:** 256K RAM, DOS 2.0 or later. OS/2 1.0 or later for OS/2 version. Magma Software Systems, 15 Bodwell Terrace, Millburn, NJ 07041; (201) 912-0192.

CIRCLE 436 ON READER SERVICE CARD



Mewel can be used to create character-mode interfaces that resemble *Microsoft Windows*.

LaserMaster's New Driver Brings Fast Printing to OS/2

HANDS ON
by Edward Mendelson

Everyone knows that printing from OS/2 is painfully slow—except users of LaserMaster Corp.'s Plain Paper Typesetters or Series III Pro (formerly LX6) controllers for the LaserJet and compatibles. Its new Presentation Manager driver lets you print from OS/2 at speeds up to ten times faster than PostScript, with far more fonts, and, if you're using a desktop printer, with higher resolution.

LaserMaster gets its speed partly from the built-in swiftness of its hardware and partly from its direct GPI driver for Presentation Manager. All other existing PM drivers force print jobs through a bottleneck while they translate PM print data into their own language. The advantage of a GPI driver can be startling. A file with four fonts and a bitmap graphic took 11 minutes and 30 seconds to print at 300 dots per inch on a LaserJet III with HP's PostScript cartridge. The same LaserJet, attached to a LaserMaster controller, printed the same file in 1 minute and 15 seconds—at an effective resolution of 800 dpi.

The LaserMaster OS/2 driver comes with 135 scalable fonts, but doesn't let you add converted Bitstream or PostScript Type 1 fonts. The character widths are written into the driver itself, and until the next version arrives later this year, you can't use any others.

Even though 135 fonts sounds like plenty, LaserMaster uses URW fonts (the company bought the American rights) whose quality, while acceptable, doesn't match the 35 Bitstream fonts that formerly came with the software. If you bought a LaserMaster board before this year, and saved the 35 Bitstream fonts you got with it, you can still use them in place of the newer fonts.

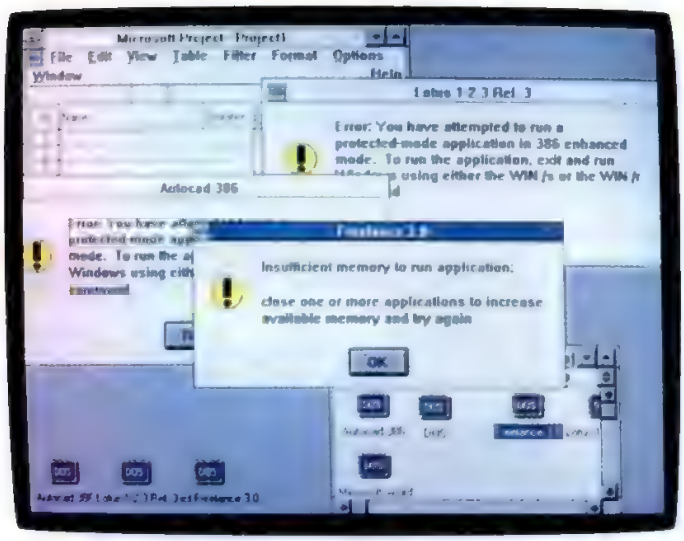
If you already own a LaserMaster controller or printer and Version 3.1 of its DOS software, you can get the OS/2 driver for a $15 shipping charge. If you have an earlier version, the upgrade to the DOS 3.1 and OS/2 drivers costs $75. You can add the Series III Pro to your LaserJet from scratch for $1,495 for a 300-dpi model with 35 fonts or $2,995 for an 800-dpi model with all 135 fonts. You may earn back the price after a few dozen print jobs. ■

List Price: LaserMaster OS/2 printer driver; $15 for owners of current LaserMaster DOS software. **Requires:** LaserMaster LX6 or Series III Pro controller, or LaserMaster 1000 Plain Paper Typesetter; OS/2 1.2 or later. LaserMaster Corp., 7156 Shady Oak Rd., Eden Prairie, MN 55344; (612) 944-9330.

CIRCLE 438 ON READER SERVICE CARD

Is Windows 3.0 the end of DESQview™?

Not if you're still using DOS programs.



Windows 3.0. The multitasking, windowing environment.

DESQview 386 2.3. The multitasking, windowing environment.

Are you still using MS-DOS programs on your PC?

You may want to use DESQview as your primary operating environment.

The new DESQview 2.3 and DESQview 386 2.3 let you use your favorite DOS and DOS-extended programs in windows side-by-side on 80286, 80386 and i486 PCs. As you can see above, you can even run Windows programs within DESQview 386. So the next time you get error messages like the ones at the left in Windows, remember how the same set of programs look running in DESQview.

Whatever standard you use—DOS, extended DOS or Windows—DESQview is still the best way to get the most out of the hardware and software you own today.

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Quarterdeck

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

This comparison was made using a system like the one you might run: Both shots show an ALR FlexCache 33/386 running DOS 3.3 with VGA display adaptor, Novell NetWare v3.01 Rev. A, with IPX/SPX v3.01 Rev A, Microsoft Mouse 7.00, and Microsoft SMARTDrive v3.03 disk cache. Buffers were set to 20. For the Windows screen, we ran Microsoft Windows 3 HIMEM.SYS and EMM386.SYS. For the DESQview screen, we ran QEMM 386 v5.1.

Trademarks: Microsoft, Windows, MS-DOS, 80386, i486, ALR, FlexCache, Novell, NetWare. ©1990 Quarterdeck Office Systems.

CIRCLE 338 ON READER SERVICE CARD

Macros and Page Designs: Two New WP Partners

HANDS ON
By Allan Davidson

Two new add-ins now simplify *WordPerfect*'s labor-intensive menus and commands. *Companion for WordPerfect*, Version 2.0, provides a menu-driven set of macros for *WordPerfect* 5.0 and later versions. *By Design* includes page design templates, graphics tools, and clip art for *WordPerfect* 5.0 and later versions. Both are compatible with *WordPerfect*'s function keys, existing macros, and users' habits.

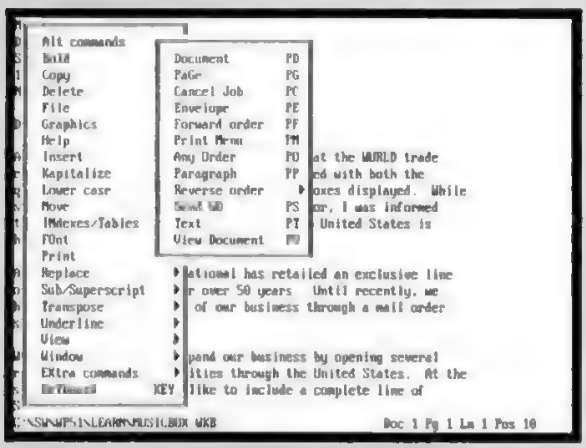
Psybourne's earlier *Companion* included macros, but had no front-end menu system. Version 2.0's new pop-up menus allow even the uninitiated to master *WordPerfect* by letting them avoid those circuitous *WordPerfect* menu options.

Companion is written using *WordPerfect*'s macro language. A well-designed installation program places some 50 files that include help screens, menus, and single letter commands in the *WordPerfect* directory and creates a subdirectory for the remaining 300-plus *Companion* macros.

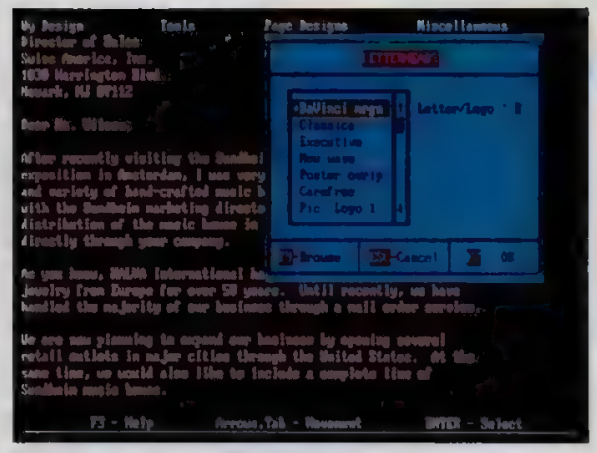
From within *WordPerfect*, the Alt-X key invokes *Companion*. A hierarchically structured system of pop-up menus allows you to perform repetitive tasks such as inserting, copying, and moving portions of your document with just a few keystrokes. For example, "B" followed by "P" bolds the paragraph where your cursor is located, "CS" copies a sentence, and so on. The commands cover text editing, formatting, printing, graphics, keyboard, and file-handling routines; most require only 2 or 3 keystrokes.

Menu selections are made by either using "point and shoot" (there is no mouse support) or by entering the mnemonic keystrokes. Once you're familiar with the macros, the menus can be bypassed. Also included is a Key Fonts program that enables you to control the size and appearance of all *WordPerfect* fonts with single keystroke commands. Other more complex *Companion* commands would take quite a few *WordPerfect* commands to duplicate. For example, you can take two similar documents and automatically merge them into a single document with side by side paragraphs, providing a document comparison tool.

You can create your own macros, and copy or change the names of existing macros, but you cannot change *Companion*'s menus.



Pysbourne *Companion*'s 350-plus commands let *WordPerfect* users cut the number of keystrokes involved in routine tasks.



By Design can format *WordPerfect* text to turn out an instant letterhead, label, resume, title page, or table of contents.

WordPerfect includes powerful graphic functions, but you need to be a graphics artist to exploit them. *By Design* offers a collection of design elements such as large characters and borders, vector-based clip art, and complete page designs—including over 50 different page designs and 11 design tools.

The program serves as a *WordPerfect* shell; when you type BD to invoke *By Design*, *WordPerfect* is loaded as well. The main program installs in your *WordPerfect* directory and then it creates subdirectories for the graphics elements and the macros necessary to use them. A second program lets you enter your name, address, phone, etc. for use with the letterhead, label, and resume page designs.

A hotkey invokes *By Design*'s drop-down menu. Menu options are divided into page designs (templates), tools (fonts, borders, etc.), and clip art (.WPG vector graphics). Further options allow you to preview the document on-screen, reset hotkeys, and adjust page elements such as margins, line spacing, and columns.

Selecting Letterheads from the Page Design menu provides you with 13 different letterhead options. You can view thumbnail previews by pressing F9; F7 accepts the highlighted template and merges it with your customized letterhead data.

The Tools option adds another degree of customization. The 11 groups of design tools include everything from fancy lead characters to decorative page borders, from special paragraph headings to any of four specially designed vector display fonts. Streetwise Software includes a built-in guidance system, where the menu items that are most appropriate for a chosen page design are automatically highlighted.

Page templates can be customized with *By Design*'s, *WordPerfect*'s, or third-party graphics tools and saved as *WordPerfect* stylesheets. *By Design* offers a host of other functions, such as creating a three-column newspaper format and accessing *WordPerfect*'s font menus with a single keystroke. ■

List Price: *Companion for WordPerfect*, Version 2.0, $99; upgrade $49. **Requires:** *WordPerfect* 5.0 or 5.1 (older versions are available without pop-up menus); Psybourne Inc., 714 Palmerston Ave., Toronto, Ontario M6G 2R1 Canada; (416) 536-6610.

CIRCLE 648 ON READER SERVICE CARD

List Price: *By Design*, Version 1.0, $89.95. **Requires:** *WordPerfect* 5.0 or later. Streetwise Software, 1227 18th St., #B, Santa Monica, CA 90404; (800) 677-0700.

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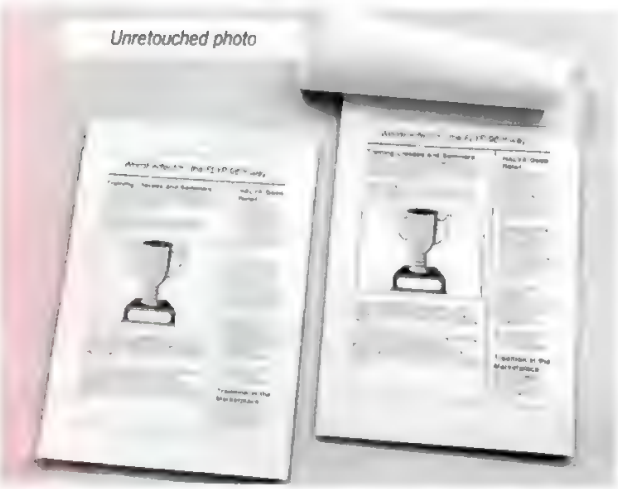

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Two New Hand Scanners: One of Many Colors and One of Many Grays

HANDS ON
by Barry Simon

Bumper crops of 8-bit hand scanners are here, and they are attempting to wow users both with price and performance. Two very notable entries are the $369 Niscan/GS which offers 256 gray scales, and the $699 Hico A4Color scanner, with support for 256 colors. By way of a comparison, the aging Logitech Scanman Plus is a 1-bit hardware scanner (software dithering makes it effectively a 32 gray-scale scanner) and costs $339.

Both the Niscan and the Hico require the installation of half-slot ISA cards; both provide 4.2-inch-wide scanning capability, both include software. If you have experience in installing cards, you'll have the hardware and software set up in 15 minutes.

Of the two scanners, the Niscan/GS has much slicker software but less-impressive hardware. The software, *Scan Express*, is made by DRI and runs under *GEM*. (Niscan supplies a runtime version.) The display screen offers a toolbox on the left and *GEM* menus across the top.

Software controls adjust the scanning density from 25 dots per inch up to 400 dpi, and adjust brightness and contrast both before and after scanning.

The Niscan/GS, an inexpensive 8-bit gray-scale hand scanner, requires a steady hand.

There are options for scanning using 16 or 256 shades of gray, or for using three different halftone dithers. There is no way to join partially scanned images, or to modify an individual shade of gray.

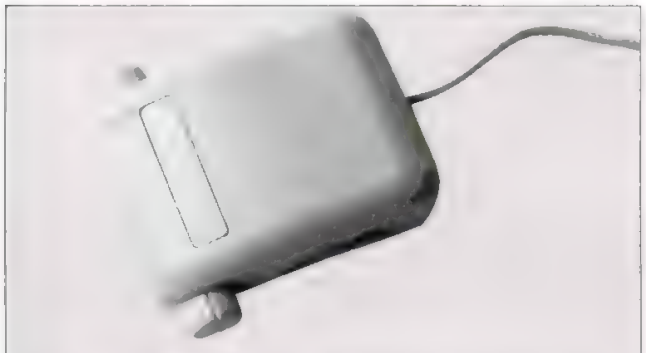
While there are certain transformation tools, *Scan Express* is not a full-fledged paint program. You can rotate an image in 90-degree increments, invert, crop, cut, as well as copy and paste rectangular or freehand regions. There's a pen and a fill tool, but notably absent are tools for adding text, drawing graphics primitives, or fat-bit editing.

The scanned image can be saved in TIFF, .PCX and *GEM* .IMG formats, but I had trouble using these saved formats with standard applications. For example, *PC Paintbrush* could not load the TIFF image; *PageMaker* wouldn't load the .PCX image. The Niscan manual suggests using TIFF images for *PageMaker* and PCX for *Paintbrush* which, in fact, worked well.

The Niscan requires a steady hand. If my scanning motion was not performed at a constant rate, the slower parts of the scan were elongated relative to the faster parts. Ironically, the Niscan ships with drivers for 16-color displays, which means you can't see the 256 gray scales on your monitor. But 256-color drivers for Paradise or 8514 cards are available from the vendor.

The A4Color scanner mixes wonderful hardware with poorly designed software and weak documentation. One of the best features is the way the scanner picks up and displays the optimum color palette as soon as you place the scanner on the image. And if you prefer, you can choose your own color palette.

The A4Color requires a supported VGA card with 512K and, in particular, will not work with an IBM VGA.



One pass 256-color scannning is in the palm of your hand with the Hico A4Color scanner.

The A4Color scanner did an excellent job of coping with an uneven scanning stroke. Furthermore, the software allows you to scan two halves of an image and paste them together—quite important for scanning larger images.

Hico's *Image 256* paint program is full featured, but many of the most important features are either not documented at all (the ability to save in .PCX or TIFF format) or documented in a READ.ME file (the Alt key acts as an eye-dropper tool in fat-bit edit mode).

Unlike *Scan Express*, there are no menus, no on-line help, and no document index. Instead, the display menu has a toolbox containing 26 inscrutable icons with no text labels.

That's not to say the software has no features. *Image 256* lets you add text in four different fonts, has a fat-bit editor, simple drawing tools, an air brush, and a fill tool. Also included is a slideshow utility that includes four different frame transitions.

Because you are enabled to export color .PCX files into *PC Paintbrush IV+* and *Deluxe Paint Enhanced* without any problems, you're working alot smarter if you scan with the A4Color scanner but leave the image editing to a more-reasonable program. ■

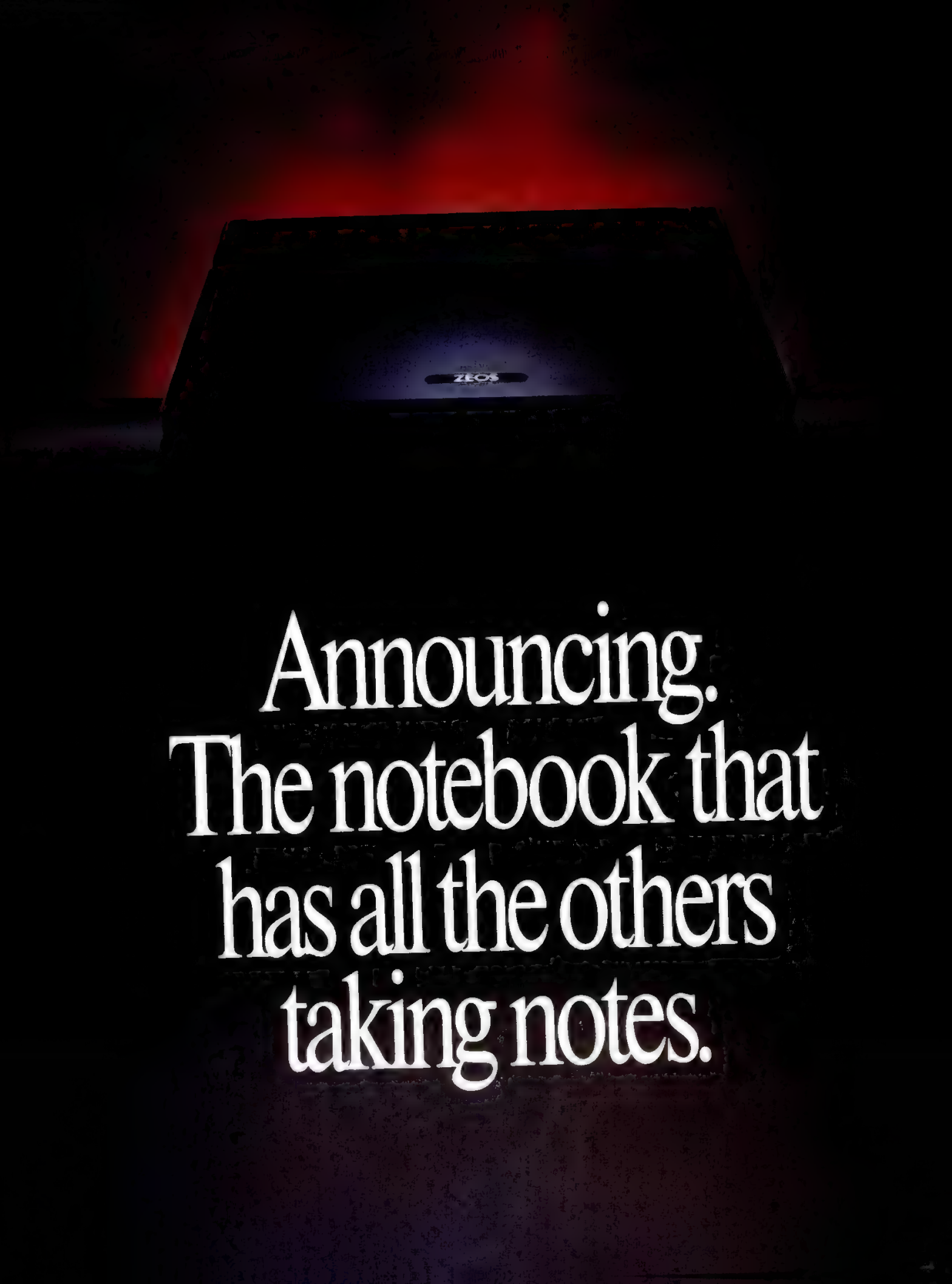
List Price: Niscan/GS, $369. **Requires:** DOS 3.0 or later, 640K RAM, *GEM*-supported video adapter. Niscan Inc., 1919 Old Debton Rd. #104, Carrollton, TX 75006; (800) 245-7226.

CIRCLE 430 ON READER SERVICE CARD

List Price: Hico A4Color Scanner, $699. **Requires:** 640K RAM, DOS 2.1 and later, supported VGA with 512K RAM. ECA C&C Products, 38 Rte. 46, E. Lodi, NJ 07644; (201) 478-0302.

CIRCLE 431 ON READER SERVICE CARD

In Short: The A4Color scanner is a superb piece of hardware—so good, in fact, that it is worth coping with its software. The Niscan/GS scanner is a possibility if you want inexpensive, 8-bit gray-scale scanning and have a steady hand.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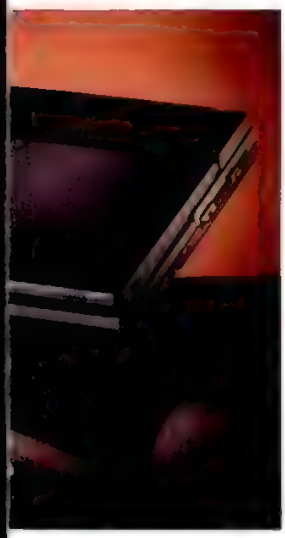

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The ZEOS Guide to the Perfect Notebook:

PROCESSOR: PC Magazine recommends a '286 pointing out that "8086- and 8088-based portables have only half to a third of the computing power of a 286." That's why your ZEOS notebook has a '286. More power for you. After all it's just like a 6.5 pound desktop!

DRIVES: *Two drives, built in!* A whisper quiet high speed 20 Megabyte hard disk *plus* a 1.44 Megabyte 3.5 inch floppy. Remember, with a built in floppy drive you don't need to fool around with strange interfaces to load and transfer files.

VIDEO: ZEOS raises the ante to VGA! We're talking about bright and crisp VGA displayed on one of the largest notebook screens in the industry. The display also features advanced fluorescent backlighting, 32 grey scales and 640 x 480 resolution. Plus, it can be adjusted to any position over a 135° angle and features easily adjustable brightness and contrast controls. Easy viewing under virtually any lighting conditions!

GREAT BATTERY FEATURES: Every battery feature you want. You can plug your notebook in and "quick charge" the battery in less than one hour or you can "trickle charge" while in use. Plus your battery easily snaps out allowing the quick installation of an optional replacement battery. It's great to be able to carry a light weight spare for those especially long trips. An optional battery charger stand is available too!

INTELLIGENT POWER MANAGEMENT: Your new ZEOS notebook features an intelligent programmable power management system if you wish to use it. Based on the length of time since your last keystroke, you may reduce CPU speed, display screen backlighting etc. Full power is immediately restored at the stroke of any key. The system even knows *not* to use the power management system when you are operating on AC power!

CHECK IT OUT!

Now, you can take desktop computing power anywhere! Your ZEOS notebook has many features of obvious importance. Also, there are a number of features that are subtle yet critical to your ultimate satisfaction. We'll go over them here one by one. We think you'll agree your new ZEOS Notebook is the one for you!

SYSTEMS STATUS AT A GLANCE: Yes, monitor eight key system components at a glance! We've equipped your new notebook with eight LED indicators which monitor disk access, keyboard functions and power status. There is even an audible alarm which may be programmed to inform you of a low battery condition and to let you know if the cover is closed with the power on. Now that's one smart notebook!

DESKTOP KEYBOARD FEATURES: We're talking 82 full size keys with full 101-key emulation. And the keyboard isn't squeezed either. The distance between the "Q" key and the "[" (left bracket) key measures 7.5 inches, just as PC Magazine suggests. The keys are of standard size, plus touch typists will love our full 3.5mm keystroke. Type for hours and love it!

CONNECTIVITY AND I/O: Keeping in touch is easy when you order our internal 2400 baud MNP Class 5 modem. Simply plug in the phone line and dial away. How about I/O ports? Many notebooks don't have them and if they do they're often non-standard. But your ZEOS notebook has *industry standard I/O*—serial, parallel and VGA. Just like your desktop!

FCC & UL APPROVALS: Your new ZEOS notebook features both FCC Class B and UL approvals. We've also met CSA and VDE requirements too, just for good measure. Quality and reliability. Built right in Minnesota by ZEOS!

WATCH THE DETAILS TOO: Like memory expandability. One Meg comes standard, you can also order a total of 3 or 5MB as a factory option. And lots of other details. Like a recessed power-on reset button, a soft carrying handle, built in speaker and more. You're going to love it! And there's no reason to wait.

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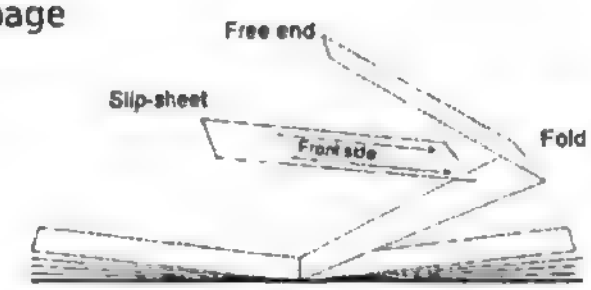
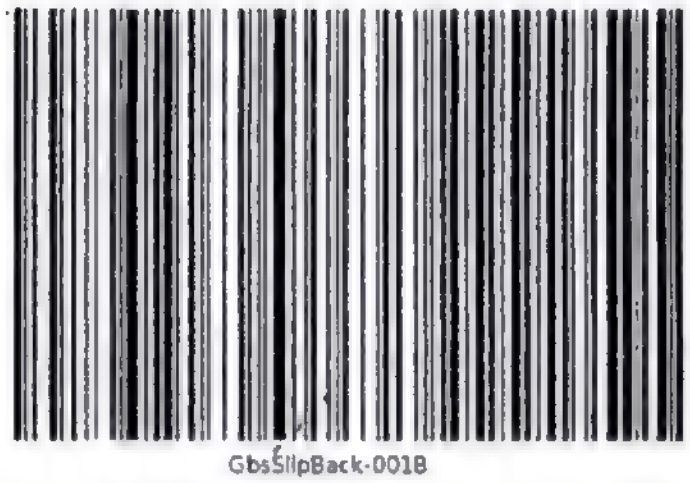
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

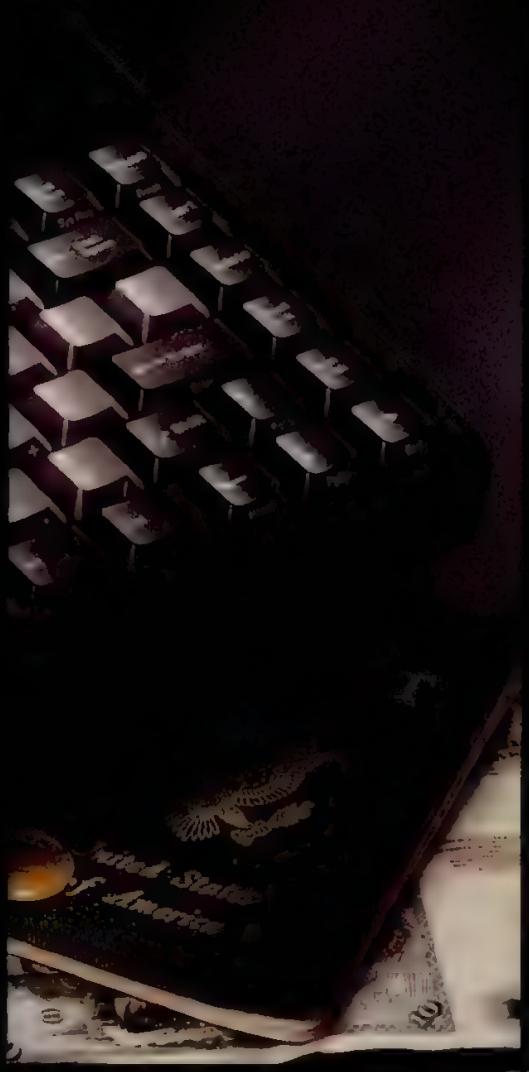


Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



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While most notebooks don't include a floppy drive at all, you're really going to appreciate your ZEOS notebook's *industry standard* 3.5" floppy. It makes loading software and transferring files a breeze. Simply toss in your 1.44 and it's done. Anyway, can you imagine a desktop system without a floppy? We couldn't either. That's why your ZEOS notebook has one. It's great!

But the features of your incredible new ZEOS Notebook don't just stop there. Detail after detail, we're giving you more than anyone else. Much more, for much less. Take a closer look.

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For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. You can also take the battery out and use the optional charging stand if you wish.

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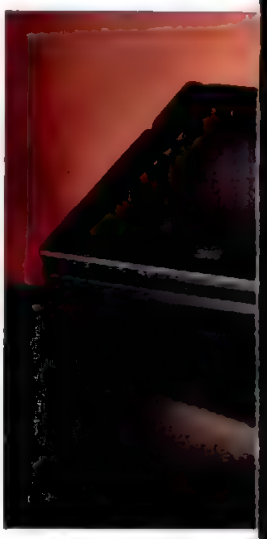
The incredible



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10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

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ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

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ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

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In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

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ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Paperless Printer Gives Presenters An Expensive, but Interesting Option

HANDS ON by Wm L. Rosch

Termed "paperless printer" by its maker, Applied Resources, the Information Station may not save the forests, but it could rescue your next presentation. The Information Station is an entirely new kind of display device—a PC-driven poster machine, a big 34-by-24-inch black-on-white display that can show PC-generated graphics.

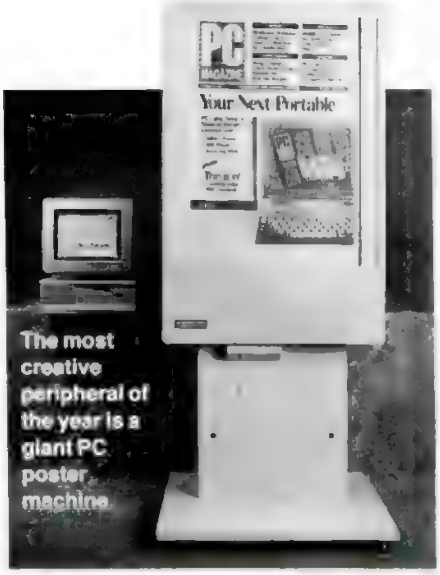
The imaging unit, manufactured by Canon and sold exclusively by Applied Resources, works something like a laser printer. It forms the image from black toner, using a full-width printhead to achieve a resolution of 72 dots per inch (dpi), 1,680 horizontal by 2,391 vertical.

Instead of printing to paper, the toner is thermally bonded onto a continuous mylar belt that is protected behind glass. After it has been displayed, the image is wiped off and the toner is recycled. The belt rotates upward, scrolling one image off as the next image is generated outside the viewing area.

The unit is big—nearly seven feet high—and expensive ($15,000, $843 more for its roll-around stand,) but it's also quick. It will roll through six full-page images a minute, filling its screen in little longer than it takes its computer host to read through a .TIFF graphic file.

Links to a PC are via a standard parallel cable which can extend up to 100 feet (a 10-foot cable is supplied with the unit). The system's menu-driven software handles image processing and transfer (images can be inverted and reversed) as well as providing facilities for manual or automatic slideshows.

The image can be viewed clearly at nearly any angle and under normal room light. Text and graphics look smooth and nongranular when viewed at distances of more than a couple of feet. The image will remain until erased.



The most creative peripheral of the year is a giant PC poster machine

Only monochrome file formats can be displayed. Images can have up to eight levels of gray, but even black-and-white dithered output is impressive.

A proprietary scanner ($2,585) allows the display of on-paper images as fast as they can be scanned. The unit can also display typed text, but only as a screen image. It has no font-generation abilities of its own.

A custom version of *Hijaak*'s file-conversion software allows translation of nearly any graphic file format on the fly, but such conversion may add 20 seconds to display time.

Although Applied Resources is targeting the sign industry, the Information Station may be the most impressive (and useful) board-room display device available. It's an impressive presentation alternative. ■

List Price: Information Station, $15,000 including cables and software. **Requires:** 286 or faster PC-compatible computer, parallel port. Applied Resources Inc. 7007 College Blvd., Overland Park, KS 66211; (800) 826-7963, (913) 469-9191.

CIRCLE 434 ON READER SERVICE CARD

VirtualVideo Producer: Screenshows Without Tears

HANDS ON by Rob Kornblum

Increasingly, the PC monitor is replacing hard copy output for disseminating information. At one end of the spectrum are the on-screen slideshow facilities built into presentation graphics packages. At the other end are complex multimedia packages that turn the PC into a stage for graphics, audio, and full-motion video. In between lies V_Graph's *VirtualVideo Producer*.

This $175 package lets you put together on-screen presentations easily, incorporating CGA to Super VGA graphics, text, simple animation, music, and even digitized speech. Menus guide you through each step in defining an event in your presentation. A simple worksheet stores all your event parameters and makes revision a snap.

The program reads .PCX files, so you can use output from many graphics packages. We had to convert some high-resolution files to lower resolutions before we could load them, though, and a lack of scaling features frequently forced us to resize images with a paint program before they would fit the VVP. A screen capture utility will soon be available.

You can overlay text anywhere on a video image or colored background using a selection of over 100 fonts in any color. You can pull text in from ASCII files or type it in directly, put boxes around it, and even allow viewers to scroll through it in a window.

If you want to liven up your presentation with animation, you can move .PCC sprite images across the screen and press enter to lock in the position. Images can only be moved in a straight line, although multiple sprites can give the illusion of zig-zag motion. Unless the images are very small and you have lightning fast video on your system, though, the movement will be slow and jerky.

The program offers a great deal of control over transitional effects. There are 27 different effects ranging from simple wipes to drips and weaves. You can overlay images or backgrounds on selected parts of the screen and erase text elements without disturbing the images. The program supports viewer-controlled branching.

Other features overlay graphics primitives on the screen, play tunes on the PC speaker, or launch other DOS programs during a presentation. The program supports several speech digitizing boards. There's also a runtime module so you can freely distribute your handiwork.

With its low price, minimal hardware requirements, and easy-to-use interface, *VirtualVideo Producer* puts a fair dose of authoring power in the hands of nonspecialized users. If you want full-fledged multimedia, V_Graph's forthcoming Version 3.0 of *Interactive VirtualVideo*—priced at $2,500—will complement *VirtualVideo Producer* with support for full-motion video and a powerful script language allowing variables and logical functions. ■

List Price: *VirtualVideo Producer*, VGA Version 3.0, $175. **Requires**: DOS 2.1, 640K RAM, hard disk, graphics card and monitor; 384K LIM EMS 4.0 required for Super VGA. V_Graph Inc., 1275 Westtown Thornton Rd., P.O. Box 105, Westtown, PA 19395; (215) 399-1512.

CIRCLE 647 ON READER SERVICE CARD

Kappa Brings AI to Windows

HANDS ON
by Daniel Rasmus

Artificial intelligence (AI) is still a dream at this point, but like many dreams, the ideas behind AI have bred practical technologies. Expert systems such as the $3,500 *Windows* 3.0-based Kappa, from Intellicorp, are the most successful of AI's spinoffs.

An expert system is so named because it mimics the reasoning achieved at the expert level for the class of problem being solved. It uses sets of predetermined rules which act upon objects that represent things or ideas in order to discover the most fitting solution to a problem.

In the past, using expert systems required massive hardware purchases and a commitment to esoteric programming languages. IntelliCorp's new expert system shell, *Kappa*, heralds a new breed. Written in C, and running under *Windows* 3.0, it transfers the functionality of large unwieldy AI systems to the desktop.

The move from LISP to C marks quite a significant change for IntelliCorp. The company's previous shell, the *Knowledge Engineering Environment* (*KEE*) required a beefed-up 386/486 or a dedicated LISP machine from either Symbolics or Texas Instruments. Acquiescing to the pressure of the business environment, IntelliCorp introduced the *Windows*-based *Kappa*, which will run on 12-MHz 286-based PCs or better.

At $3,500, *Kappa* represents the middle of the road in expert systems technology. Many smaller, less-capable shells such as Paperback Software's *VP Expert* and Emerald Intelligence's *Mahogany* are available for under $1,000, while large shells, including *KEE*, sell for well over $10,000 a copy.

Kappa is an object-oriented programming system that includes functions for rules and procedures and runs under *Windows* 3.0. The heart of *Kappa* is the Kappa Application Language (KAL). KAL allows developers to represent real-world things and ideas as objects and then develop sets of rules to reason upon them.

Kappa's objects support a rich class structure and full inheritance capabilities. Values for objects are stored in slots. A typical object, like BUICK: COLOR, might hold the value BLUE in the slot COLOR. Values for slots can be derived from the knowledge base itself, from rules and functions written in KAL, or from C programs linked into the development environment. *Kappa* supports forward, backward, and mixed-mode reasoning, but the manual suggests that developers define forward and backward chaining rules separately and that the mixed mode of reasoning be avoided.

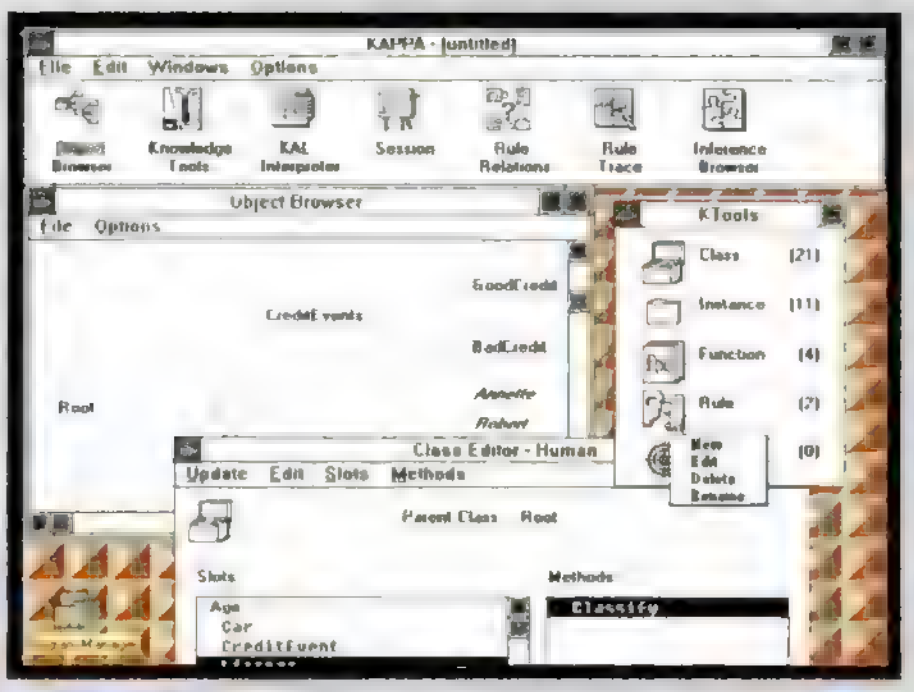
Kappa's development console is attractive and easy to understand. Programmers are asked to define rules, patterns and analytic functions without relying on more traditional procedural programming. Clicking on an appropriate icon will invoke editors, browsers, or an inference session. Some icons are linked to pop-up menus for execution of multiple functions like editing or deleting rules and objects. *Kappa* includes a session icon that can be linked to a custom user interface complete with buttons, scrolling windows, and animated objects. The use of this interface slows down the systems' performance, but makes *Kappa* a self-contained development environment. Other products, like Neuron Data's *Nexpert Object*, rely on environments like *HyperCard* and *ToolBook* for developing the interface. This leaves their allocation of the processor time to inference processing.

For maximum flexibility and performance, *Kappa* also comes as a set of C libraries that can be linked into custom applications. So, any programming environment with access to C libraries can benefit from the knowledge processing capabilities of *Kappa*.

The primary difficulty with *Kappa* stems from its lack of integration with the *Windows* 3.0 environment. *Kappa* supports DDE but it lacks facilities that buffer developers from the grueling rigors of entering code in text editors. In contrast, examining the text version of a knowledge base in *Nexpert Object*, a competing product, can confuse you—but Neuron Data does a good job of sheltering developers from their code structure through intelligent editors that support pop-up menus for controlling syntax and copying keywords and objects. Although *Kappa* runs under *Windows* and supports graphics, its development environment is primarily character-based.

Kappa's input is accomplished in austere text edit windows, with no help from a graphic interface. Pop-up windows are used to copy keywords and objects, but they are without context. Navigation inside *Kappa* is also poor. You cannot move from one rule to the next without a dialog box intermediary and there is no way to jump from the object editor to the rule editor. IntelliCorp needs to concentrate on embedding *Windows*' GUI philosophy into *Kappa*.

The current incarnation of *Kappa* is a useful tool, but probably not for the masses. Its syntax is difficult and relies too heavily on character-based operation. The price is a bargain to those coming from the expert systems community, but it's quite steep for the PC *Windows* world. (A $450 runtime version takes some of the sting away.) Still, by porting this well-known LISP program to C and *Windows*, IntelliCorp is demonstrating a clear understanding of the future of AI. ■



Kappa uses Windows icons and navigation techniques, but the Windows metaphor breaks down during the creation and editing of rules and objects.

PC FACT FILE

***Kappa*, Version 1.1**
IntelliCorp, 1975 El Camino Real, W. Mountain View, CA 94040-2216; (415) 965-5500.
List Price: $3,500 for development systems, $450 each for runtime.
Requires: 12-MHz 286 or better. 640K and EGA graphics required.
In Short: *Kappa* is an exciting entry into the expert systems market. Since it comes from one of the leaders in AI technology, hopefully it will continue to grow in features and abilities. Version 1.1 is compact and runs medium-size systems in 640K, but its lack of integration with the *Windows* paradigm will keep it in the hands of systems developers rather than opening up opportunities for new users.

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With Headroom you can hot-key between up to 32 application programs – so you can switch from your word-processor to your database to your spreadsheet with a touch of a key! But unlike other swapping and switching "merry-go-round" programs, all your TSRs are *always fully functional!*

Headroom is so fantastic that PC Magazine said *"Headroom performs more death-defying escapes from DOS's 640K straightjacket than any other program."*

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TSRs remain fully functional	✔		✔	✔
TSRs operate with each other	✔			
Load unload TSRs as you go, in any order	✔			
Control Free RAM used by device drvrs.	✔			✔
Use extnd. or expnd memory or hard disk	✔	✔		
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Requires LIM 4.0 hardware to operate	NO	NO	YES	YES

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- 2 SERIAL PORTS, 1 PARALLEL PORT AND 1 GAME PORT
- 8 EXPANSION SLOTS
- KEYBOARD SELECTABLE CPU SPEED
- REAL-TIME CLOCK/CALENDAR AND BATTERY
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- 5 5¼" HALF-HEIGHT DRIVE BAYS
- 200W POWER SUPPLY
- SYSTEM BOARD MADE IN THE U.S.A.
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- ***OPTIONAL 64K CACHE:*** *ADD $500*

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- 101-KEY TACTILE FEEDBACK KEYBOARD
- 2 SERIAL PORTS, 1 PARALLEL PORT AND 1 GAME PORT
- 8 EXPANSION SLOTS
- KEYBOARD SELECTABLE CPU SPEED
- REAL-TIME CLOCK/CALENDAR AND BATTERY
- SUPPORTS INTEL 80387 & WEITEK 3167 CO-PROCESSORS
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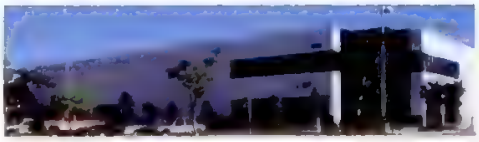

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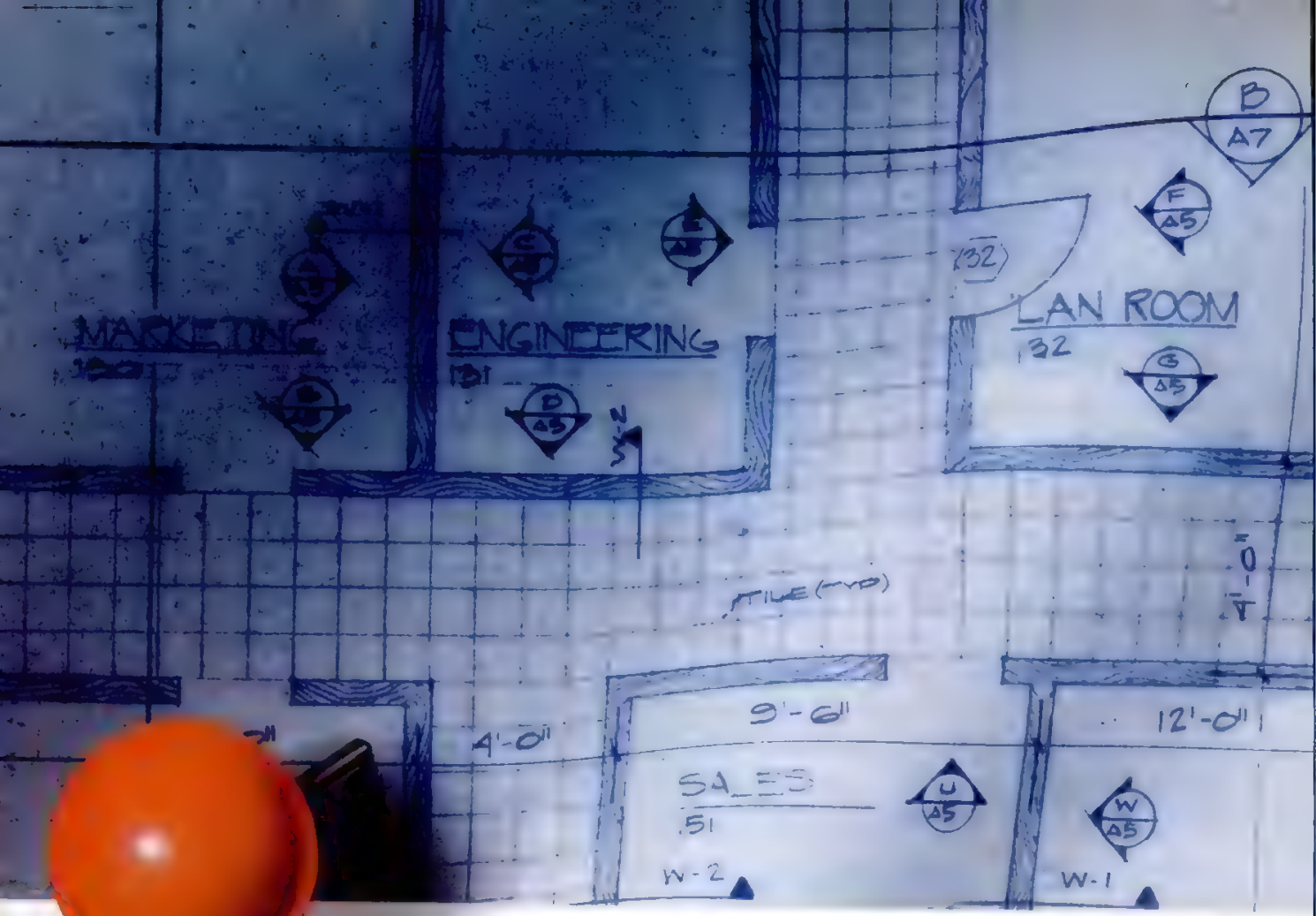
CIRCLE 163 ON READER SERVICE CARD



NetPort™ makes sticking another printer on the network almost this easy.

With Intel's new NetPort print server, the hardest thing about installing printers on the LAN will be deciding where you want them. NetPort practically does the rest. NetPort installs in minutes on Novell® NetWare® networks, without the inconvenience of other printer methods. In fact, NetPort lets you connect printers or plotters directly to the network at any thin-wire Ethernet® T-connector.

And talk about hassle-free. NetPort requires no VAP or NLM, and installation is completed using standard NetWare menus. NetPort's parallel and serial ports can be used simultaneously, supporting up to two printers.

What's more, the NetPort print server is completely self-contained, so it doesn't use additional memory in the workstation or the file server. And it's amazingly compact, so it doesn't use valuable real estate in the office.

So now there's no reason to put up with the constraints of going through dedicated PC-based print servers or third-party print utilities to do what NetPort does in a snap—put printers on the LAN.

To get NetPort on your LAN, just see your Intel dealer, or call Intel at (800) 538-3373. If you'd like more information on NetPort faxed directly to you, call (800) 525-3019 and request Document #9930.

Get NetPort. And don't get stuck with printer installation problems. CIRCLE 374 ON READER SERVICE CARD

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by Rink Murray

New & Improved

News of Announced Products and Upgrades

Following the Current Trend, Compaq And ALR Introduce Upgradable CPUs

NEW

Compaq Systempro 486

Promising adequate speed for the present and future, Compaq Computer Corp. announces its first 486-based Systempro. The 486 Systempro, based on Intel's 33-MHz 486 processor, utilizes a new 512K ServerCache design on the processor board. Compaq also has begun to ship 486/33 System Processor Boards, which let users upgrade any Systempro to a single or dual 486 system. The Systempro 486 ships with 8MB RAM and either an 840-, 420-, or 240MB hard disk array. According to Compaq, the Systempro delivers "a range of processing performance from 8 to 40 MIPS (million instructions per second)," depending on the hardware configuration. Upgradable CPUs are part of a recent effort to hedge against obsolescence.

List Price: Compaq Systempro 486-240, $20,999; 486/33 System Processor Board, $6,999; upgrade from 386, $4,999. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; (713) 370-0670.

CIRCLE 439 ON READER SERVICE CARD

ALR Business Series

Advanced Logic Research also announces an upgradable server, its Novell-certified BusinessServer. The BusinessServer ships as a 33-MHz 386 or 486 with EISA, ISA, or Micro Channel configuration. The unit features 8MB RAM (upgradable to 49MB on the 386 and 128MB on the 486), an 800-watt UPS, and eight full and three half-height drive bays. The 128K cache is optional. Expansion ranges from seven slots on the Micro Channel version to nine slots on the EISA versions.

ALR also adds the Business VEISA 386/33, which is designed to give end users an affordable path to 486 computing. Simply by exchanging CPU modules, users can upgrade to either a 25- or 33-MHz 486. The BusinessVEISA supports up to 17MB on the motherboard (up to 49MB of RAM with the optional ALR VEISA Memory Expansion Module), 1.2MB 5.25-inch floppy disk drive, an IDE hard disk controller, a keyboard, and a mouse port in its base configuration, with an optional 64K cache. The BusinessVEISA has four half-height drive bays, and nine expansion slots including six EISA.

List Price: BusinessServer 33/386 (ISA) or BusinessServer VEISA 33/386, 330MB hard drive, $14,999; BusinessVEISA with 1MB RAM, 1.2MB 5.25-inch floppy drive, $1,995. Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; (714) 581-6770.

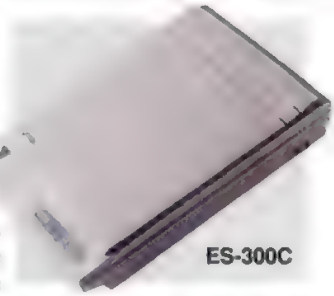
CIRCLE 440 ON READER SERVICE CARD

Epson and Four Others Introduce Scanners

NEW

ES-300C

Epson America enters the color scanning market with the ES-300C, a desktop image scanner that promises one-pass color at a price competitive with many monochrome scanners. Measuring 4.8 by 12.6 by 20.1 inches (HWD) the ES-300C utilizes 8-bit monochrome processing to produce 256 shades of gray, and 24-bit color processing to produce 16.8 million colors at 300-dot-per-inch (dpi) resolution. The scanning mechanism has three gas-filled light bars—red, blue, and green—that scan each line of the image and separate the colors simultaneously, a process Epson claims is faster than conventional scanners which use a single light bar that rescans through color filters. The ES-300C makes color corrections during the scanning process, and with Epson's direct print feature, the ES-300C outputs directly to some color printers. The optional Interface Kit ships with a full software palette including: *HALOscan*, Image In's *Scan, Paint and Plus*, Astral's *Picture Publisher Plus*, and *Color Lab ES-300C*. The ES-300C takes advantage of character recognition software.



ES-300C

List Price: ES-300C, $1,995; Interface Kit, $495. Epson America Inc., 23530 Hawthorne Blvd., Torrance, CA 90505; (213) 539-9140.

CIRCLE 441 ON READER SERVICE CARD

CONTINUES ON PAGE 56

HOT PROSPECT

ATI MAKES V.42BIS AFFORDABLE

At $799, ATI Technologies' 9600etc/e modem is among the first in the rapidly developing market for 9,600-bit-per-second modems that support V.42bis error correction and data compression protocols. The 9600etc/e is backward compatible with modems operating MNP Level 5 data compression and MNP 2-4 protocols, and supports the 2,400-, 1,200-, and 300-bps standards. According to ATI, by combining V.32 protocol with V.42bis, the 9600etc/e effectively transmits and receives data at 38,400 bps. The 9600etc/e's ESP Easy Set Panel provides push-button access to common commands including speed select, modem diagnostics, auto-answer, and data mode.

List Price: 9600etc/e, $799. ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; (416) 756-0718.

CIRCLE 437 ON READER SERVICE CARD

New&Improved

IMG Series

Fora brings three flat-bed scanners to market: the IMG-511 gray-scale model and two nongray-scale models, the IMG-311 and the IMG-321. With the ability to scan legal-sized documents at 300 dots per inch and supporting up to 256 gray scales, the IMG-511 is the flagship of the Fora line. Bundled with Astral's *Picture Publisher*, the 511 also scans line art and half-tone graphics, and has 15 built-in downloadable half-tone patterns.

The IMG-311 and 321 are nongray scanners that represent up to 145 gray levels at resolutions of 300 dpi and 400 dpi, respectively. Both of these scanners ship with MicroArt *Image Editor*. Fora also offers a $2,495 variation of the IMG-311 as a high-speed OCR solution. Called the Turbo IMG-311 OCR, it ships with automatic sheet feeder, high-speed interface card, and *OmniPage 386*.
List Price: IMG-511, $2,190; IMG-321, $1,695; IMG-311, $1,450; Turbo IMG-311 OCR, $2,495. **Requires:** 80386 PC with 4MB RAM and *Microsoft Windows* 2.03 or later, but not 3.0. Fora Inc., 3081 N. First St., San Jose, CA 95134; (800) FOR-FORA, (408) 944-0393.

CIRCLE 442 ON READER SERVICE CARD

AVR 3000 Gray Scale Image Scanner

Advanced Vision Research's AVR 3000 Gray Scale Image Scanner uses the HP ScanJet Plus software interface and lists for $1,790 bundled with Astral's *Picture Publisher Plus*. With built-in controls for scale, crop, brightness, and contrast, the AVR 3000/GS flatbed scanner handles documents as large as 8.5 by 14 inches at resolutions up to 300 dpi. The 3000/GS's Universal Scanning Engine has three modes of operation: as a 256-shade gray-scale scanner; a 16 user-selectable/definable dithering pattern scanner; and a Lineart mode scanner for black-and-white images. AVR also intends to ship a full-featured color scanner due out in October.
List Price: AVR 3000/GS, $1,790.
Requires: Requirements dependent on software used. AVR, 2201 Qume Dr., San Jose, CA 95131; (408) 434-1115.

CIRCLE 443 ON READER SERVICE CARD

NuScan PC Gray Scale Scanner

Asuka Technologies Inc. introduces the NuScan PC Gray Scale Scanner, a $399 hand-held scanner that renders 256 shades of gray at a density up to 400 dpi. The NuScan can handle pictures and documents 4.1 inches wide and 14 inches long. But the bundled Perceive Automatic OCR software includes an append function that seamlessly combines multiple scanner passes, and supports typefaces 8 to 36 points.
List Price: NuScan PC Gray Scale Scanner, $399. **Requires:** 1MB RAM, hard drive, 80386, DOS 3.1or later. Asuka Technologies Inc., 17145 Von Karman Ave., #110, Irvine, CA 92714; (714) 757-1212.

CIRCLE 444 ON READER SERVICE CARD

Personal Scan

Targeted at businesses that need a versatile scanner for under $1,000, DEST offers Personal Scan—a combination full-page hand-held and edge-feed scanner that produces 64 gray-scale levels at resolutions up to 300 dpi. For hand-held operation, the Personal Scan scanning carriage detaches and can handle documents 8.5 inches wide, thus eliminating the need to paste documents together. When placed in the desktop edge feeder, the hand-held unit can scan up to ten pages automatically. Personal Scan ships standard with *Recognize!*, DEST's OCR software.
List Price: Personal Scan, $995.
Requires: 640K RAM, DOS 3.0 or later. DEST, 1015 E. Brokaw Rd., San Jose, CA 95131; (408) 436-2700.

CIRCLE 445 ON READER SERVICE CARD

CONTINUES ON PAGE 58

IMPROVED

***XTreeNet*, Version 2.0**—This is the LAN version of the Editor's Choice DOS shell application, *XTree Pro Gold*. *XTreeNet* takes advantage of Novell *NetWare*'s functionality. With Version 2.0's peer-to-peer communications network, administrators have unlimited power to view and manipulate files in any directory on the network. Version 2.0 allows users to implement string searches, launch applications, attach and detach commands, get an S-List of servers, compress and archive directories, PRUNE and GRAFT entire directories, and manipulate print jobs. Other features in Version 2.0 include an easier installation procedure and the ability to access multiple servers—although users must purchase a separate license for each server. *XTreeNet*, Version 2.0, retails for $249 for the ELS version. *The Advanced/SFT/386* version is $495; Version 1.0 users can upgrade to either for $95. Contact XTree Corp. in San Luis Obispo, Calif. at (805) 541-0604.

With *XTreeNet*, network managers can view files.

SideTalk II—Lattice upgrades its multitasking telecommunications package to include MNP Level 5 error correction and data compression, a new user interface, and an enhanced telecommunications programming language. *SideTalk II*'s pull-down menus and function keys give users one-keystroke-access to common telecommunications tasks. And, in addition to the 25 prewritten programs already included, *SideTalk II* provides more than 100 functions for developing automated file transfers, customized calling scripts, and bulletin boards. Like the original *SideTalk*, *SideTalk II* can operate as a memory resident program, and can operate in the background. *SideTalk II* retails for $125, and upgrades are $75. Contact Lattice Inc. in Lombard, Ill. at (708) 916-1600.

HP DeskJet—As laser printer prices continue to drop, Hewlett-Packard lowers the price of its DeskJet and announces several enhancements. The new DeskJet is backward-compatible with previous models, but ships with more fonts, including CG Times and Letter Gothic, a better nonwater soluble ink, a three-year warranty, and a *Windows* 3.0 driver with scalable fonts. The new DeskJet is aggressively priced at $729. Contact Hewlett-Packard in Cupertino, Calif. at (800) 752-0900.

***Scrapbook+*, Version 2.0**—Eikon Systems announces that its graphics management utility for *Windows* 3.0 is shipping. *Scrapbook+* lets users store and manage all graphics, clip art, scanned images, screen shots, and boilerplate text in a single file. Users can view the images and transfer them into other *Windows* applications. Version 2.0 adds support for .PCX, .CGM, and .DRW file formats, and support for *Microsoft Excel*'s proprietary clipboard format, BIFF. Version 2.0's help window offers scrollable help text with hypertext links, and can remain on-screen while *Scrapbook+* runs in another window. *Scrapbook+*, Version 2.0, retails for $149.95 with a $30 upgrade. Contact Eikon Systems Inc. in Foster City, Calif. at (415) 349-4664.

CONTINUES ON PAGE 58

Limited time offer to owners of Microsoft C

Borland's Turbo C++ Professional "Everything you always wanted in a C compiler and more"

—Reprinted from *PC Magazine*, August 1990

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Special upgrade offer for Microsoft® C owners!

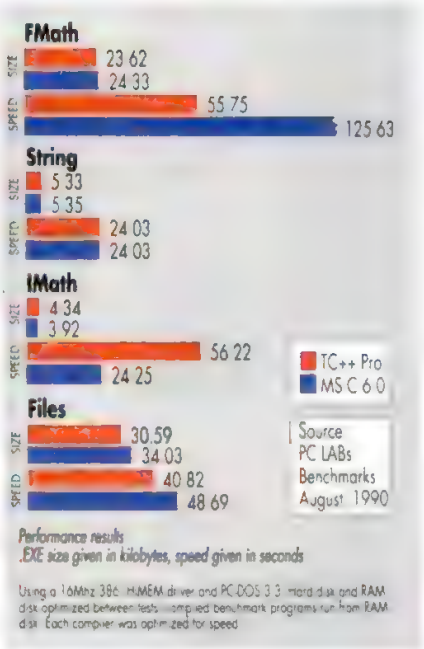
Are you ready for an upgrade that conforms 100% to ANSI C, gives you C++, doesn't skimp on documentation, features a fast, reliable programming environment, and provides the complete toolset necessary to maximize your productivity? Then it's time to make the move to Borland.

And the time to move is now. We're offering Turbo C++ Professional to owners of Microsoft C or any PC-based C or C++ compiler for only $149.95.*

Compare the features.

COMPILER	MSC 6.0	TC++ Pro
C++	NO	YES
Full ANSI C	NO	YES
Transparent overlay manager	NO	YES
Complete printed documentation	NO	YES
ENVIRONMENT		
Overlapping windows	NO	YES
Mouse support	YES	YES
Integrated debugging	NO	YES
TOOLS		
Debugger	YES	YES
Profiler	NO	YES
Macro assembler	NO	YES

Turbo C++ Professional beats Microsoft C 6.0.



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—*PC Magazine*, August 1990

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Good News for Network Managers

NEW

As an aid to LAN administrators, Frye Computer Systems brings *NetWare Early Warning System*, Version 1.0, to market. Version 1.0 can work in the background under *Windows* 3.0 and can analyze as many as 150 servers on a single Novell network, searching for more than 50 types of errors. Version 1.0 checks the server automatically and repeatedly, and logs all error information on either a network or local drive. Different users can be notified for each server. Problems detected by Version 1.0 include: server not responding, FAT (file allocation table) write errors, insufficient space, insufficient directory entries, physical hard disk errors, and lost or discarded packets.
List Price: *NetWare Early Warning System*, $295. **Requires:** 512K RAM, Novell *NetWare* 2.1*x* (Partial support for *NetWare* 2.0A and 3.*x*) DOS 2.0 or later. Frye Computer Systems Inc., 19 Temple Pl., Boston, MA 02111; (617) 451-6711.

CIRCLE 446 ON READER SERVICE CARD

MousePen for Portables

NEW

APPOINT's MousePenPortable is specifically designed for use with portable computers. Operating like a pen with a resolution from 50 to 1,000 dpi, the MousePenPortable avoids many problems encountered by mice which require more desk space. The MousePenPortable is Microsoft and PS/2 compatible and is bundled with *TelePaint*, a VGA paint program.
List Price: MousePenPortable, $149. APPOINT, 1332 Vendels Circle, #101, Paso Robles, CA 93446; (800) 448-1184 (outside Calif.) or (805) 239-8976.

CIRCLE 447 ON READER SERVICE CARD

Third-Party Fonts for HP DeskJet Plus

NEW

Elesys offers four inexpensive cartridges for the HP DeskJet Plus. The Elefont Desk Cartridge includes CG Times, CG Triumvirate, Prestige Elite, and Letter Gothic fonts at sizes from 5 to 16 points. The Elefont Headline Cartridge offers fonts ranging in size from 11 to 30 points. The Elefont Cartridge Plus combines the Headline and Desk cartridges into a complete font package. Also available are Elememory Cartridges, which increase printer memory by either 256- or 128K.
List Price: Elefont Desk Cartridge, $199; Elefont Headline Cartridge, $199; Elefont Cartridge Plus, $299; 128K Elememory Cartridge, $119; 256K Elememory Cartridge, $169. Elesys Inc., 528 Weddel Dr., Sunnyvale, CA 94089; (408) 747-0233.

CIRCLE 448 ON READER SERVICE CARD

ARK Is a Toolbox for ToolBook Developers

NEW

For *Windows* 3.0 application developers, Asymetrix Corp. has announced the Aysmetrix *ToolBook* Author's Resource Kit (ARK). ARK lets users distribute royalty-free copies of runtime *ToolBook* and the three DLLs included with *ToolBook*. The DLLs include: a DLL that provides access to *dBASE III* files; a DLL for determining the characteristics of a display device, determining which fonts are available for display and printing, as well as setting and retrieving values in a *Windows* initialization file; and a DLL for performing DOS functions within a *ToolBook* script. Other features include a script remover that prevents users from copying or reading an author's source code.
List Price: ARK, $495. **Requires:** 2MB RAM, floppy and hard disk, *Windows* 3.0, mouse, and DOS 3.1 or later. Asymetrix Corp., 110 110th Ave. NE, #717, Bellevue, WA 98004; (206) 462-0501.

CIRCLE 449 ON READER SERVICE CARD

OS/2 App to End Office Paper Clutter?

NEW

Imara Research Corp. introduces *Imara*, a workgroup image and information management system designed to streamline paper storage and trafficking. Instead of depending on paper copies, *Imara* stores documents as images, automatically compresses images as they are scanned in to the system. *Imara* can concurrently blend fax, e-mail, scanner, and text retrieval into a single network. Users can view single or multiple documents, append notes, and link documents. *Imara* requires OS/2 and works with most networks.
List Price: *Imara*, $2,495. **Requires:** 8MB RAM, 100MB hard disk, OS/2 v1.2 or later on the server. Imara Research Corp., 111 Peter St., Toronto, Ontario, Canada M5V 2H1; (416) 581-1740.

CIRCLE 450 ON READER SERVICE CARD

IMPROVED

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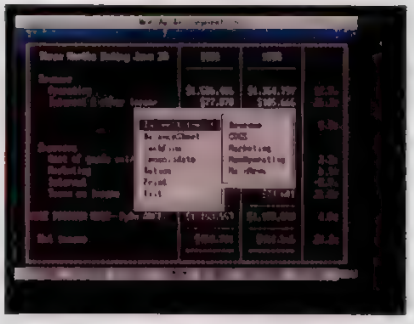
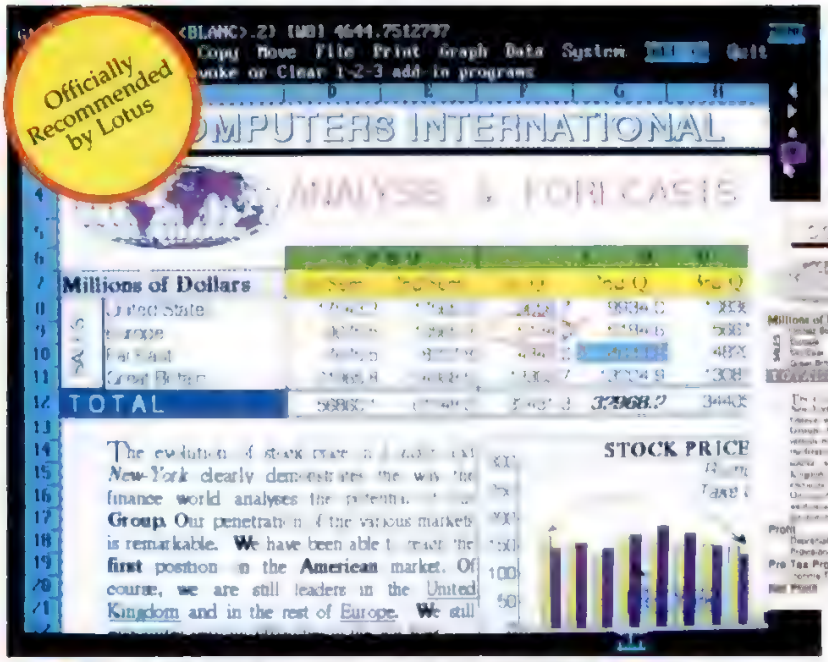


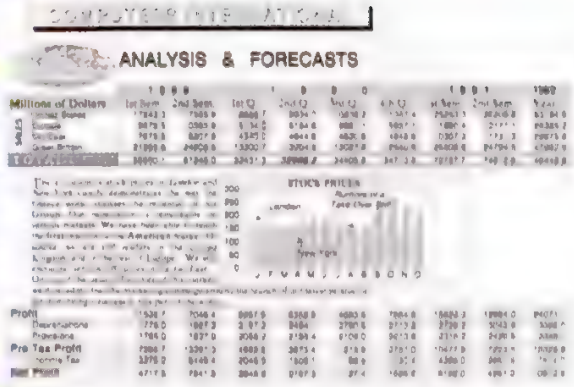
BalerXE creates applications by customizing *1-2-3* worksheets.

BalerXE—Baler Software Corp.—maker of *Baler* 5.0 spreadsheet compiler and customizer—has begun shipping an extended edition. *BalerXE* expands on Version 5.0's library of customizing tools by allowing users to develop their own additions via BASIC, C, Pascal, or Fortran. In addition to this new "open architecture," other *BalerXE* features include the ability to build and/or remove run engines, the addition of *dBASE*-style input templates and validations, enhanced graph printing, and 13 new macro commands. Because of its security features, which hide formulas and macros from the end users, *BalerXE* can transform any worksheet into a professional tamperproof program. *BalerXE* retails for $795. To upgrade from *Baler* 5.0, users should contact Baler Software Corp. in Rolling Meadows, Ill. at (800) 327-6108 or (708) 506-9700.

***Gray F/X*, Version 1.1**—Xerox Imaging Systems announces an upgrade to its 8-bit image processing software for desktop publishing. The expanded Filter Set gives users greater control over visual effects like sharpen, edge, sculpt, emboss, blur, posterize, despeckle, and line segment. Version 1.1 allows users to save workspace information as a template that can later serve as a stylesheet. Other new features include: enhanced masking capabilities; improved cursors, icons and brush display; user ability to set up functions for scanner, monitor, and printer field upgrades; an improved scan-menu interface; and several specialized features that allow the user to outline, highlight, fill, distort, cut and paste, rotate and add text. *Gray F/X* 1.1 retails for $495; upgrades from 1.0 are $75. Contact Xerox Imaging Systems in Sunnyvale, Calif. at (408) 245-7900.



Lotus 1-2-3 stays fully active in graphics mode with PC PUBLISHING IMPRESS. 1-2-3 works just like before, only now you have your own customized 1-2-3 screen display and reports.



What you see on your new 1-2-3 screen is what you get on paper with PC PUBLISHING IMPRESS

When your 1-2-3 Worksheet looks IMPRESSive so do You

PC PUBLISHING IMPRESS gives 1-2-3 true desktop publishing features that enable you to create eye-catching and persuasive worksheets.

1-2-3 Stays Fully Active

With PC PUBLISHING IMPRESS you can call all 1-2-3 commands and menus. You never need to revert back to text mode for editing cells.

Drawing Tool Box with an Optional Mouse Support

PC PUBLISHING IMPRESS brings a true graphic interface to Lotus 1-2-3. Full mouse support to call menus or open windows. Even a drawing tool box that allows you to draw any image in 1-2-3. Get a professional look quickly and easily without ever leaving 1-2-3.

Compress or Enlarge Worksheets

You can customize your 1-2-3 screen display with drawings, colors, grids and new exciting fonts. You can also zoom in and out to compress worksheets or enlarge them. See twice as many rows and columns of your worksheets on screen. No more scrolling around.

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Create a professional report with numbers, graphs, images and text all on one page. Your graphs are customized. Your text automatically word wraps and is justified. You have a choice of different type styles and sizes with different fonts (3 pts. to 72 pts.). Many Bitstream Fonts included and new Bitstream fonts can be added. Your images are created with the drawing tool box or imported from Freelance or Harvard graphics.

Prints on All Printers

Print sideways on you laser printer. Works with all dot matrix, desk jets, and laser printers. Print exciting colorful reports with color printers. PC PUBLISHING IMPRESS can also compress worksheets automatically so they fit any page size you want.

Customize Graphs or Forms

Graphs can be real time synchronized with your worksheet. You can also include .PIC files or Freelance files. Customize your 1-2-3 graphs with arrows, explanations, fancy titles and drawings. Draw lines, boxes, grids or even freehand to create any form or invoice from inside 1-2-3. Then fill up your forms on screen and simply print them.

Easy to Use

If you know how to use 1-2-3, you already know how to use PC PUBLISHING IMPRESS, it's fast and easy. There is no learning period. IMPRESS uses 1-2-3 like menus that you are already familiar with.

Allways and 1-2-3 Rel 2.0, 2.01, & 2.2 Compatibility

PC PUBLISHING IMPRESS is compatible with Allways files. So you can improve them, or simply work on them without having to toggle to text mode. IMPRESS works with 1-2-3 Rel 2.0, 2.01, & 2.2.

Technical Requirements

IMPRESS works with: *1-2-3 release 2.0, 2.01 or 2.2, DOS 2.0 or later, CGA, EGA, VGA or Hercules (No color in CGA). Supports all graphics printers that work with 1-2-3: including Dot Matrix, Desk Jet, Laser printers (Hewlett Packard, Postscript, etc. . .), Color printers. IMPRESS occupies 93k RAM above 1-2-3 (uses EMS if available). Many Bitstream Fonts included with package. 1-2-3 is a registered trademark of Lotus Development Corp*

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"IMPRESS . . . a clear leader worthy of an excellent score. If you like Allways, you'll love IMPRESS."

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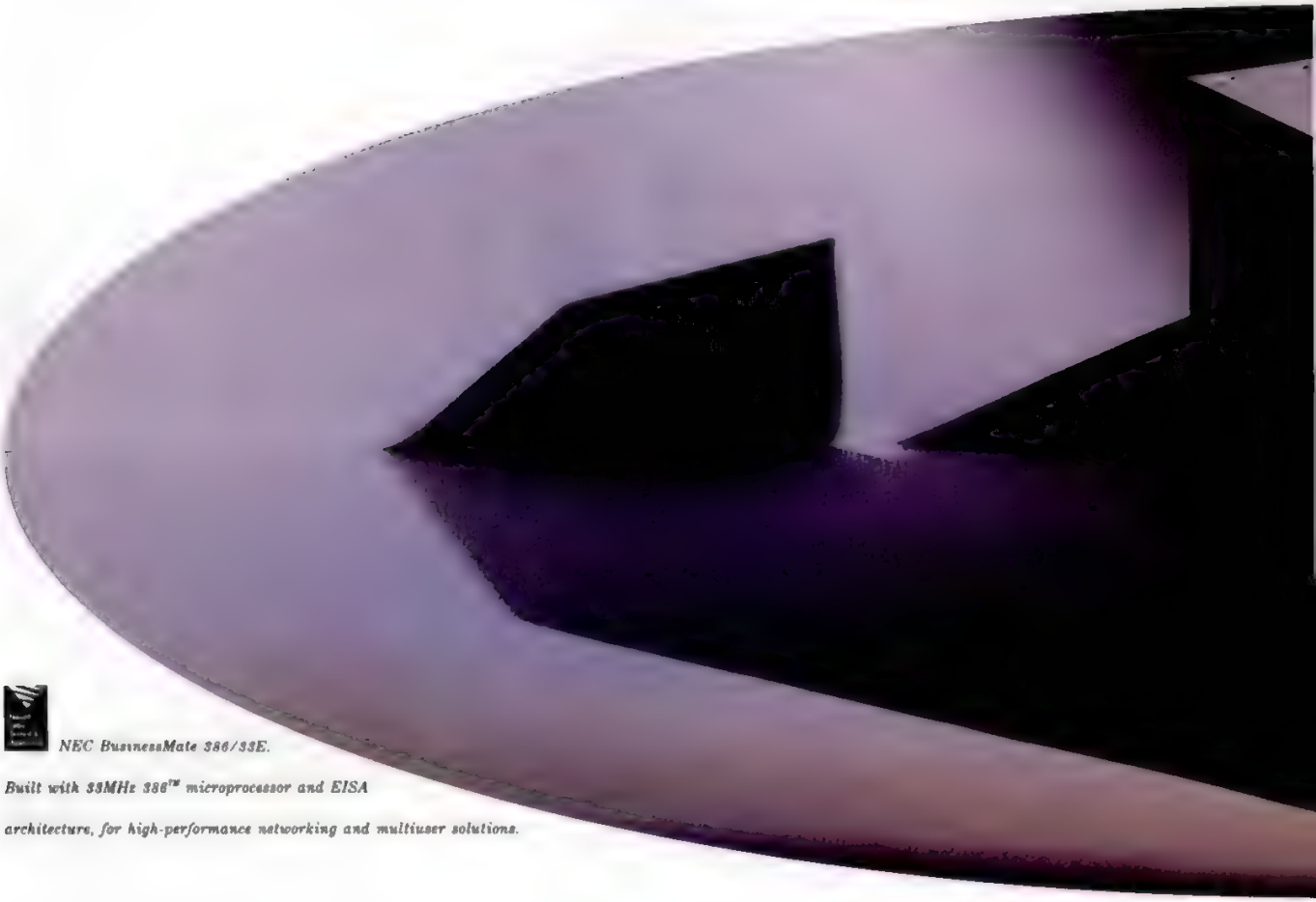

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NEC

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CIRCLE 184 ON READER SERVICE CARD

edited by
Matthew J. Ross

Read Only

Reviews of the Latest Books for the PC User

Enhancing Desktop Publishing and Presentation Designs

■ *Newsletters from the Desktop: Designing Effective Publications with Your Computer*
by Roger C. Parker
Ventana Press, $23.95

If you need to develop design skills fast, buy *Newsletters from the Desktop* by Roger C. Parker. This introduction to desktop publishing consists of six well-structured chapters that outline the nuts and bolts of newsletter design: from choosing a grid, and fine-tuning body copy style, to finalizing a page with graphic accents.

The process described is Parker's own, and exhibits a few personal prejudices—like his belief that indented paragraphs are more intimate than those formatted flush left. The book's overview approach touches just about every aspect of design that a novice will need. However, by skimming (or ignoring) topics, such as multiple signature publications, printing production, and advertising grids, Parker limits the long-term usefulness of this book.

My biggest complaint is that the subtitle "Designing Effective Publications with Your Computer" is misleading. Information about hardware and software is relegated to asides and two superficial appendices. Parker misses opportunities to show how good design can be accomplished electronically. Brand names rarely appear in this volume.

Buy this book for its solid introduction to newsletter design. The glossary is thorough, and the extensive bibliography and source guide will point you toward other valuable information. But be warned, precious little in *Newsletters from the Desktop* relates to the computer on your desk.—**Luisa Simone**

Ventana Press, Chapel Hill, NC 27515; (919) 942-0220.
ISBN: 0-940087-40-5

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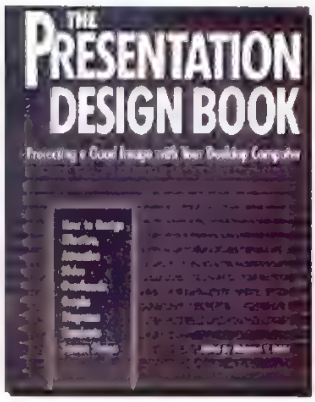

***The Presentation Design Book* is an excellent resource for learning how to create effective presentations.**

■ *The Presentation Design Book*
edited by Margaret Y. Rabb
Ventana Press, $24.95

The Presentation Design Book contains all the basics for presentation planning. Defining the scope of a presentation in terms of objectives, budget, and production resources; preliminary planning such as outlining and story boarding; and an overview of production are all presented in Margaret Y. Rabb's book.

Useful tips about scaling type for projected materials are typical of *The Presentation Design Book*'s practical "how-to" approach.

The book provides a good discussion of the pros and cons of different presentation media, and a step-by-step approach to creating renderings, proofing materials, and creating speaker notes. However, Rabb does not provide enough information about production issues for readers who will be working with out-of-house designers and agencies.

The chapters "Understanding Type" and "Exploring Color" describe how to select and scale type fonts and coordinate colors to obtain different effects and styles. Later chapters stress the importance of using simple, consistent images whenever possible. The author emphasizes that "good graphic design is invisible."

The book's appendix includes layout templates for creating 3-D graphics and a 20-page resource directory of graphics suppliers.

The Presentation Design Book's narrative style is enjoyable to read, and makes it easy to follow the author's excellent advice. Take it, and your audience will thank you.—**Doug Dayton**

Ventana Press
ISBN: 0-940087-37-5

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■ *Type From the Desktop: Designing with Type and Your Computer*
by Clifford Burke
Ventana Press, $23.95

In *Type From the Desktop*, Renaissance man Clifford Burke combines respect for the venerable traditions of printing and typography with excitement about the speed and convenience of computing.

Burke addresses fundamentals such as concept and context, audience, format, and structure. He demonstrates how white space and letter shapes work to create dynamic layouts. He also examines specific processes important to building a text layout: establishing margins and line lengths, selecting type size and leading, choosing an alignment scheme, and adjusting word and letter spacing.

By illustrating such improvements as kerning, Burke shows the necessity for "tiny adjustments that are so important in the subliminal responses of readers."

Burke charts an absorbing thumbnail history of type, from Gutenberg through today's digitized fonts. His notion of creating coherent collections of typefaces is invaluable to the neophyte and the seasoned practitioner. And throughout the overview, Burke points out how and why particular faces work, or don't work—at 300 dots per inch.

Burke can't resist some justified Helvetica bashing. In fact, he uses this book to show PC users alternatives to that old sans serif workhorse and its fellow desktop old gray mare, the serifed Times Roman. Burke exhorts his readers to try Optima and Palatino in particular, with instructions to maximize their effectiveness.

Burke does not mention specific software programs in this design primer; rather, he introduces design craftsmanship into a field giddy with its own speed. His book will enable computer users to do the same.—**Beth Tondreau**

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by Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Anti-aliasing Techniques Hold Promise to Dramatically Improve VGA Resolution

Eliminating the jagged edges inherent in PC-level video has been the subject of much research. The easiest solution is very expensive: increase the number of addressable pixels to achieve a very fine resolution.

The smarter way to smooth curves is a technique called anti-aliasing. It defines a softer line for the erratic angles formed when a dot-matrix tries to simulate a curve.

IBM's done the most experimentation with the concept, but a small company in Waltham, Massachusetts, is close to having the biggest impact with the technology.

Edsun Labs is in the process of signing up VGA board makers to use a digital-signal processor with encoded anti-aliasing algorithms that it's developed. Metheus and Monolothic are the first manufacturers to commit to using the chips. Edsun is starting to have some success because its design is a simple replacement for a standard VGA-board part.

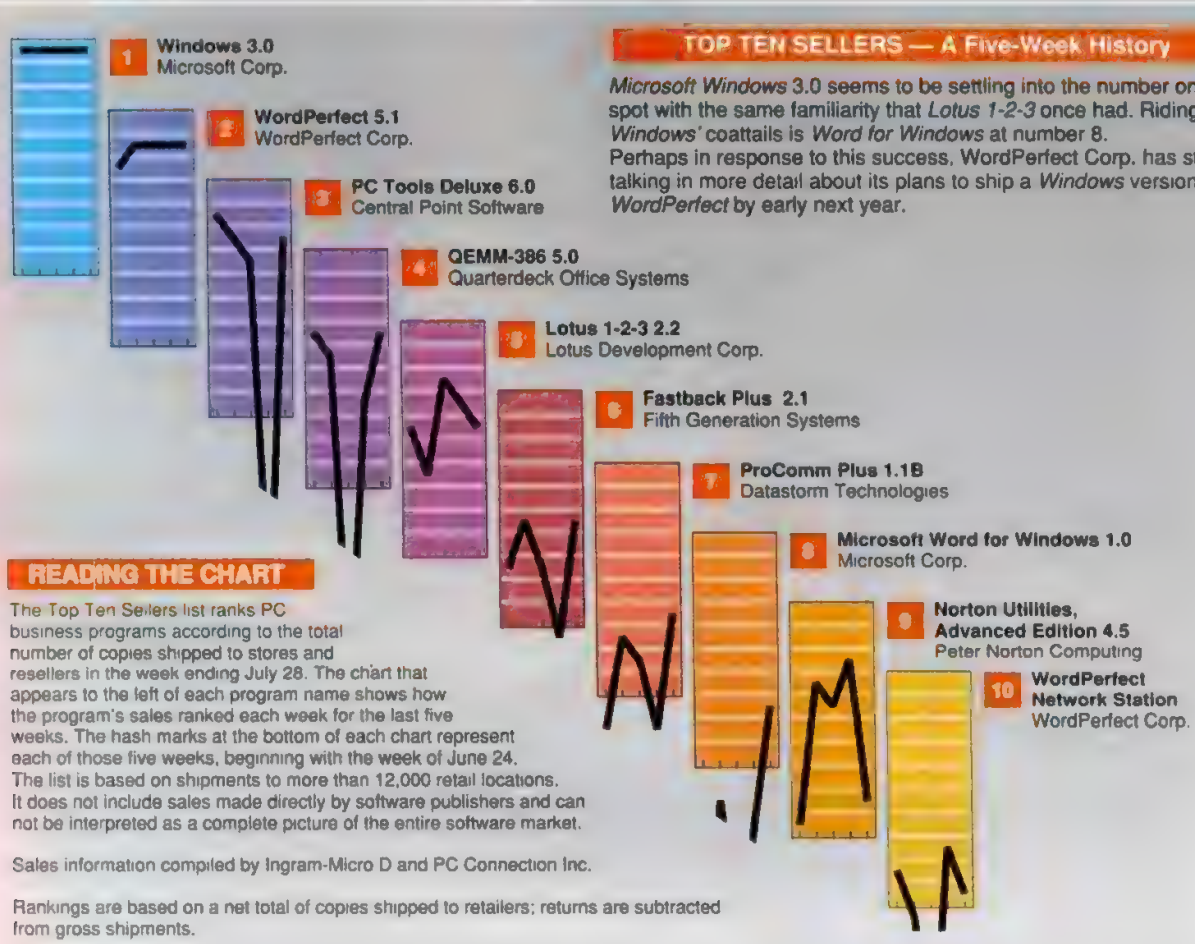
Most VGA boards use either a Brooktree or INMOS chip to provide the DAC (digital-to-analog conversion) and Look-Up Table RAM; Edsun's CEG-DSP (Continuous Edge Graphics Digital Signal Processor) is pin-compatible with those chips and provides the same function with the added benefit of anti-aliasing.

Essentially, instead of telling the monitor to display the specific color called for by software, the CEG-DSP computes a graduated color transition whenever an edge is going to be displayed, using mixes of the basic red-green-blue spectrum. Where an edge drawn by an existing VGA board will be two distinct colors at adjacent pixels, the CEG-DSP drives the monitor to

CONTINUES ON PAGE 66

TOP TEN SELLERS — A Five-Week History

Microsoft Windows 3.0 seems to be settling into the number one spot with the same familiarity that *Lotus 1-2-3* once had. Riding on *Windows'* coattails is *Word for Windows* at number 8.
Perhaps in response to this success, WordPerfect Corp. has started talking in more detail about its plans to ship a *Windows* version of *WordPerfect* by early next year.



READING THE CHART

The Top Ten Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending July 28. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of June 24. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a complete picture of the entire software market.

Sales information compiled by Ingram-Micro D and PC Connection Inc.

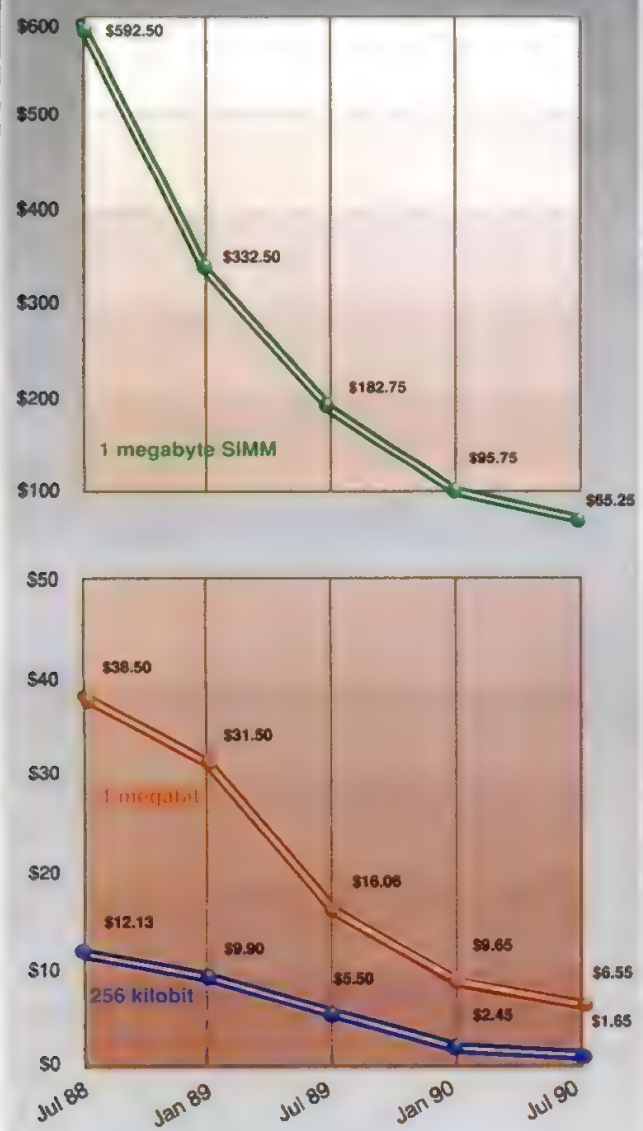
Rankings are based on a net total of copies shipped to retailers; returns are subtracted from gross shipments.

RAM Prices Drop to $60 a Megabyte

RAM prices continue to slide, though at a slower rate than a year ago. The cost of adding one megabyte of memory to empty slots, which dropped to just about $100 early this year, is now closer to $60. And for the first time, the cost of using SIMM packs is virtually the same as using older individual chips.

These prices are averages of published retail prices for 256-kilobit, 150-nanosecond RAM chips, 1-megabit, 100-ns. chips, and 1MB, 100-ns. SIMM packs from July 1988 through the end of July 1990.

1MB SIMMs only became available for retail [illegible] significant premium over other forms of RAM.



Pipeline

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display mixed colors, so that pixels at an edge might be comprised of 33 percent green for the foreground and 67 percent blue for the background, with adjacent pixels displaying 100 percent green and blue. Instead of a staircasing effect, the resulting edges are smooth.

Graphic representations of objects can be made far more realistic since more colors are possible through mixing, but more importantly, the smoothing technique dramatically increases the readability of graphic-based typefaces.

Because the chip enhances an existing function in typical VGA designs, existing software and monitors will take advantage of the technology.

If the DAC/Look-Up Table chip on VGA boards were socketed instead of soldered, there would be a large market for the chip. Instead, Edsun's design will probably come to market on newly introduced boards. Rumors abound that companies like Compaq, Epson, and Tandon are testing the device.

Right now, it seems to be the easiest way to make a dramatic increase in the quality of VGA displays without rendering anything else obsolete.

Hand-Held Scanner Makers Unite

Recognizing that chaos helps no one, seven manufacturers of hand-held scanners have agreed to develop a single applications program interface (API) for future devices.

Logitech, KYE, Diamond Flower, The Complete PC, Qumax, Marstek, and Info Corp. have formed a task force to develop a hardware specification that would be shared, paving the way for software publishers to control each company's scanners with a single software interface.

Right now, a publisher of graphics or character-recognition software seeking to market a program that accepts input directly from a hand-held scanner needs to write seven different versions of the scanner-interface code.

> Seven manufacturers of hand-held scanners have agreed to develop a single applications program interface (API).

The agreement represents a triumph of diplomacy, since the seven had spent months arguing over the direction of the API. Logitech had initiated the process and asked the other six companies to adopt its own specification. After several rounds of negotiation, all seven agreed to create an API that would give all an equal voice in writing the standard.

Meanwhile, several manufacturers of full-page scanners have started to discuss a similar agreement. If successful, an API for full-page scanners would build on the hand-held standard, so that the same software could control character-recognition software.

Multiuser DOS Federation Formed

A group of vendors with wide-ranging interests have joined together to further the success of multiuser DOS systems.

The group, called MDOS (Multiuser DOS Federation) has an agenda that is part- marketing and part-technology driven. It's comprised of representatives from Advance Micro Research, Alloy, Arnet, Concurrent Controls, DigiBoard, Digital Research, IGC, Link Technologies, Star Gate Technologies, StarPath Systems, The Software Link, SunRiver, THEOS Softwater, Viewport International, and Zaki.

The one unifying interest is the shared use of a single PC within DOS standards. The

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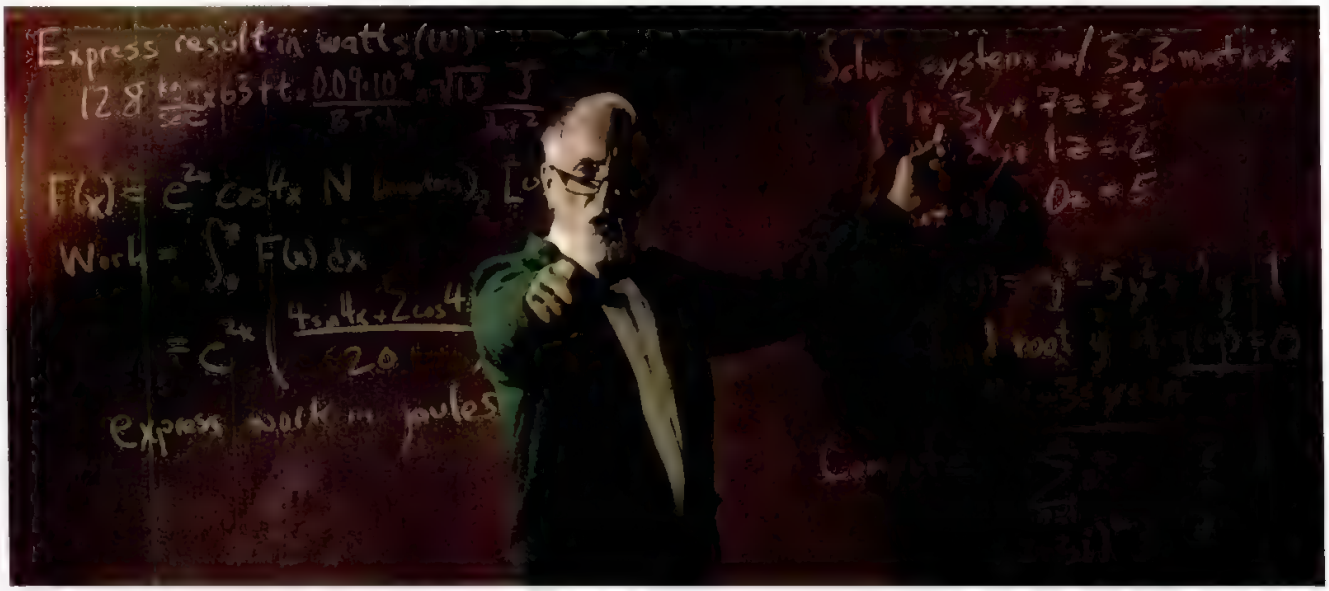

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PC MAGAZINE EDITOR'S CHOICE
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Best of '88
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Pipeline

CONTINUED FROM PAGE 66

companies in the group sell terminals, make boards that let several terminals run off one PC, or develop DOS-compatible operating systems that permit multiple users to access the same PC.

The federation plans to publish standards for programming, peripheral interfaces (video, terminal, and serial) and DOS memory management techniques.

Success on the technology agenda is far from guaranteed. The companies in the group have a variety of conflicting interests and, unlike scanner manufacturers, have no clear objective to be gained from cooperation other than making it easier for customers to move from one multiuser product to another. Digital Research's *Concurrent DOS* and The Software Link's *PC-MOS* have little common ground nor is there a compelling need to find any.

It's the kind of problem that has kept the Open Software Foundation's effort to establish a common Unix standard mired in bureaucratic debates, with competing companies arguing over which core version of Unix to use under the Motif interface.

If the group succeeds in making multiuser systems more attractive it will be because the members want to extend the feature-sets of their products to establish links with other systems that are clearly competitive. That will require long-term planning for every one of the MDOS Federation members.

> It's the kind of problem that has kept the Open Software Foundation's effort to establish a common Unix standard mired in bureaucratic debates.

From Software To Board Game; Carmen Sandiego Travels Again

First *Tetris* proved that a PC could be the breeding ground for a brilliant game. Now Carmen Sandiego, Broderbund's game-based detective, is using PC software as a springboard to other media.

Western Publishing, a leading publisher of children's books, will launch a series of books, games, and puzzles featuring the peripatetic problem solver next year.

Broderbund initially launched the series as a geographically minded quiz game called *Where in the World Is Carmen Sandiego?* several years ago; when that version proved to be quite the smashing success, later versions used Carmen in explorations of both the USA and Europe. And, before long Carmen will be made into the featured star of TV programs, both as a Saturday-morning cartoon and a public-television educational quiz shows.

Spinnaker Sells Education Line To Concentrate on Business

One of the pioneers in educational software, Spinnaker, is getting out of that business to concentrate on developing productivity applications.

Queue Inc. is buying Spinnaker's educational line for $1 million, freeing the company to devote its resources to programs like *Plus*, the *Windows* and OS/2 application generator with HyperCard compatibility.

Educational software made up 11 percent of Spinnaker's revenue for the last year. ■

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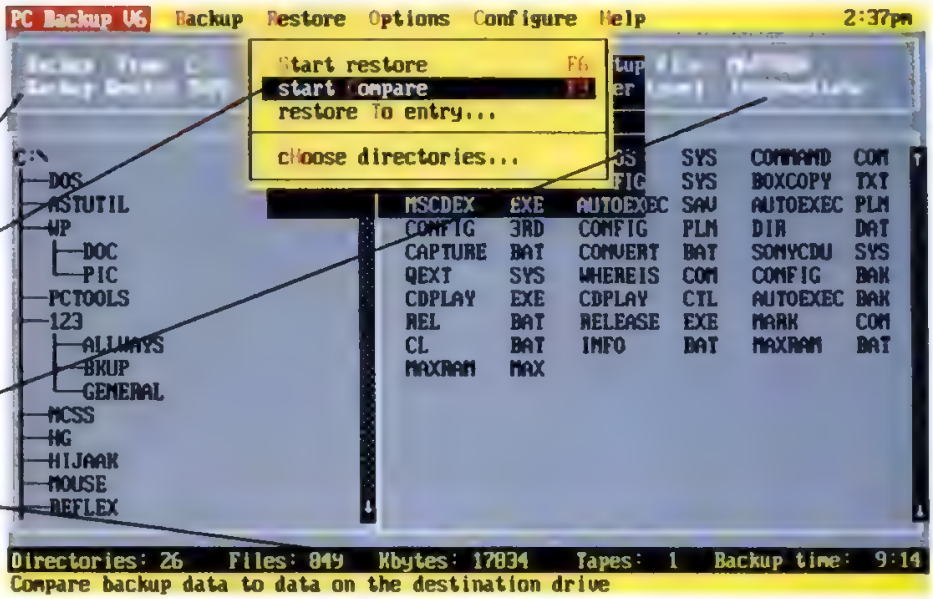

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—PC Magazine, Jan. 16, 1990

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Ed Mendelson, PC Magazine "Best of 1989 Awards," January 16, 1990

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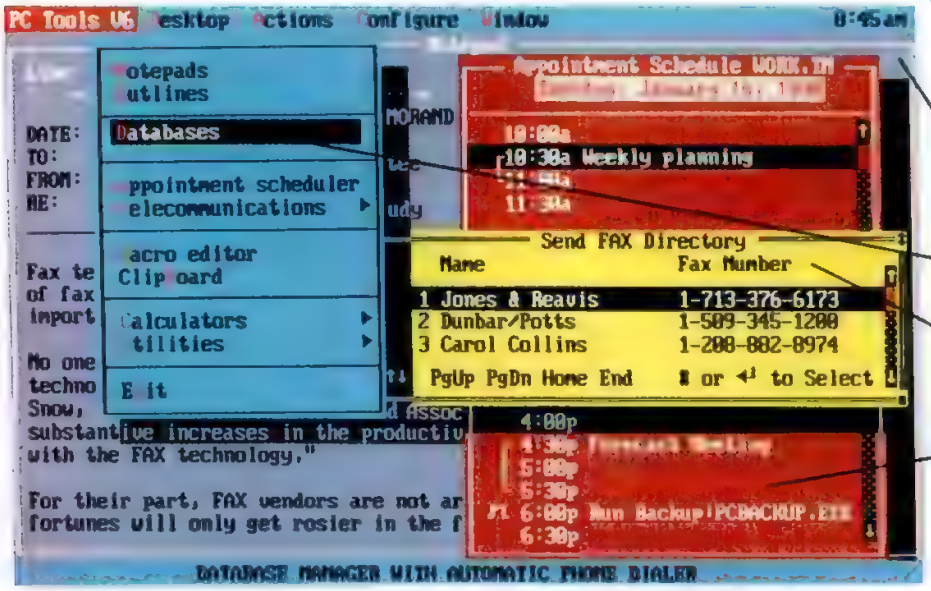

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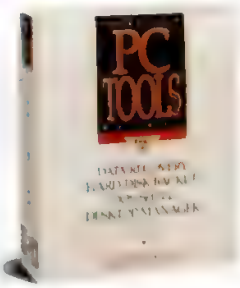

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Bill Machrone

Upgrading The Installed Base

When in doubt throw it out. Or upgrade it. Or sell it. Or something. How do you deal with yesterday's hardware?

Look at the machines around you. A significant percentage of them don't fully meet your needs. The hard disk may be too small. The processor is too slow. It's monochrome, and not even Hercules at that. Look at the machine in front of you. You paid good money for it, and it was probably the state of the art when you bought it. Remember Machrone's Law. (The machine you want always costs $5,000.)

If your company paid for it, what the heck, it's on the depreciation schedule and maybe there's somebody you can foist it on so you can requisition a new 386. It's a whole different ball game if you paid for the computer yourself. You can't afford to replace your machine every time somebody comes up with a better idea or a faster processor.

The results couldn't have been clearer in our survey of reliability, service, and support, to which we devoted the previous issue of *PC Magazine*. One of the questions we asked was, "How much longer will the machine you're using meet your needs?" People with 386 machines generally predicted a long and happy life, sometimes as much as five years. The horizon was much closer for 286 users. Some of them stated flatly that they'd already outgrown their computer. Interestingly, we got a split vote on XT-class machines. Most respondents said that they'd outgrown it, while a small but noisy group said that they planned to keep their XTs for a long time. These folks had used their own money and their needs were still being met by the original machine. Or so they rationalized.

BUY THE INSTRUCTION SET

Owners and users of 386 machines have good reason to be so content. They've bought into the instruction set that will take them through the decade. Not that there won't be faster, cheaper machines. Not that there won't be technological innovations. Not that there won't be a 586 and a 686. But some things will remain stable—the aforementioned instruction set, the basic architecture of extended memory, and protected mode.

Some computers will benefit more than others from new technology. Chief among them are home computers circa 1995, which will have highly integrated digital signal processing. DSP will give these machines extraordinary video and audio capabilities. Businesses will be able to make use of these features, too, but in more-specialized applications, such as presentation graphics, real-time video teleconferencing, instructional programs, and voice- and video-annotated electronic mail.

In the meantime, we're seeing some pretty weird behavior in the name of cost-effective PC purchasing. I moderated a trade show panel on upgrading the installed base at PC Expo in New York back in June. In the question-and-answer segment, one of the audience members said, "I've got a VP of finance who is going around the country buying up old 6- and 8-MHz IBM ATs. He says that's the most computing power anybody needs. We're choking on our own data at this point. What do we do?"

In reply, I asked what kind of computer the VP was using. It was a Compaq 386, of course. Clearly, he needed to be given a dose of his own medicine. The panel also asked the attendee

ILLUSTRATION: STEPHEN SWENY

what the heck the VP of finance was doing buying the company's computers. The company seemed sufficiently large, with enough PC-literate people, to spread the purchasing decisions around. This kind of top-down micro-management has no place in today's business. If top management wants controls, they have budgets, standards, and approvals.

This imperious dispensing of obsolescent technology is bound to backfire on several

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Bill Machrone

fronts. First, it's not cost-effective in the long run. Pressure will inexorably grow to replace or upgrade these machines. Second, users resent it like crazy. One other observation from our massive reliability survey is that people are more satisfied when they are involved with the purchase of the machine. That's no big revelation, that's human nature. And our VP of finance is flouting it at his peril.

There's a limit to how far you can pass PCs down in your organization. "Give it to some clerk for word processing" is rife with misconceptions. Too many machines are transferred just because of executive privilege. The boss gets a faster, fancier machine because it's state of the art. Meanwhile, it may be doing nothing more than gathering e-mail off the LAN or displaying a calendar. Today's word processing, however, is much more demanding of machine resources. Even the fastest assembly language programs, such as *WordPerfect* and *XyWrite*, get clunky on old hardware. Some features, such as page preview, may be unusable. We've had much more luck giving our old XTs menial network jobs such as print and task servers. A couple are grinding away right now separating PostScript images into four-color plates in our art department.

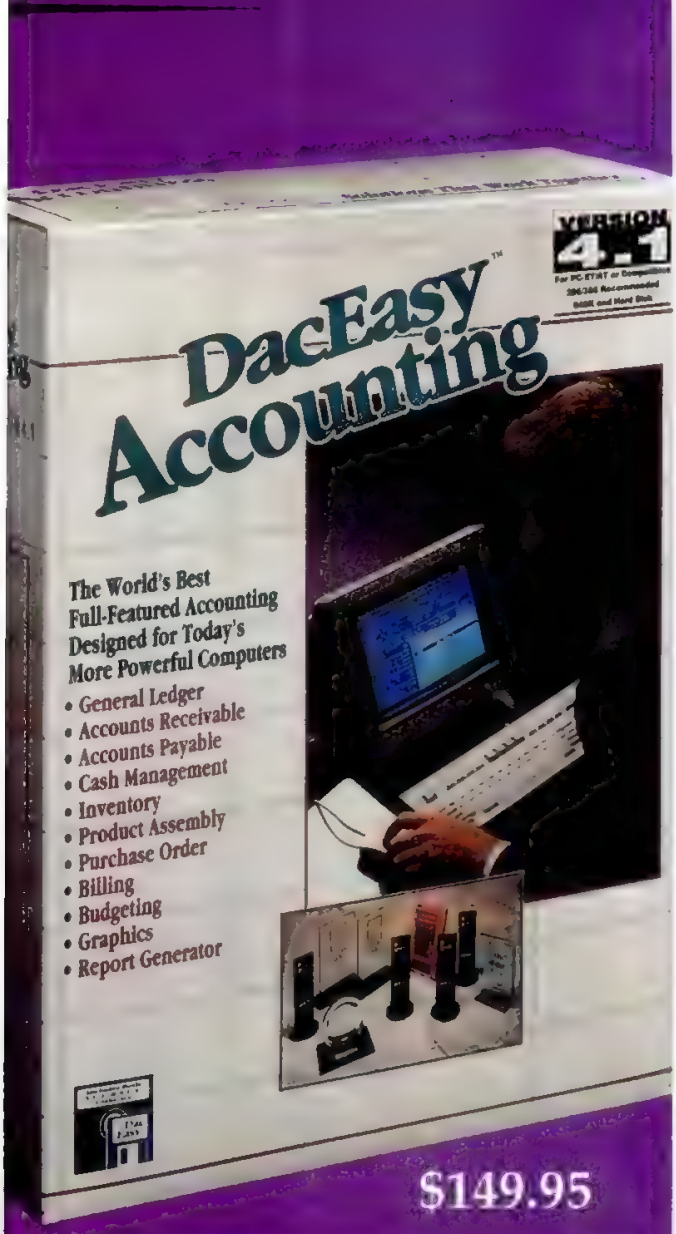
A PRESCRIPTION

My PC Expo panel had some pointed recommendations to make, to which I wholeheartedly subscribe. Work toward a 386, but watch the cost of replacing just the motherboard. Don't fall in love with the box. You might create a machine with an old, slow hard disk, ancient video, and a blazingly fast processor.

Look for opportunities to sell old computers. You can get money for any IBM or Compaq system. The Boston Computer Exchange even lists the going wholesale price on a week-by-week basis. You can resell other brands, but finding a brokerage to handle them won't be easy.

Don't upgrade a Macintosh; replace it with a newer model. Macintosh upgrades are generally not cost effective.

And consider donating old machines to worthy causes. Schools, churches, and community organizations need what you've got. You get a tax deduction and a chance to buy the machine you really need. ■



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John C. Dvorak

The Japan, Inc. Hoax

Are the Japanese as efficient as we make them out to be?

It was a few years ago that a friend of mine—who spends most of his time in Asia—said, "It's a myth that the Japanese are harder workers than Americans. The fact is they ain't outworking us, they're outsmarting us." This must be the case since any visit to Japan turns up one peculiar fact: the Japanese are incredible time wasters.

If you haven't been to Tokyo, you aren't missing much. While much of Japan is beautiful, Tokyo itself is a miserably unplanned sprawl. Visits from company to company can easily take hours in travel time. Hours. The traffic is incredible; it seems like one long 24-hour traffic jam. This is not helped by the fact that most of the cab drivers like to take the scenic route. To them, going around the Cape of Good Hope is a shortcut.

Anyway, while the Japanese may make an efficient assembly line, the Japanese style of doing business is the opposite. It's a miracle anything gets done.

In Japanese business circles it's considered prestigious to be the last one home from work. So to make it look like you're the last one home the Japanese white collar workers (mostly males) hit the streets and meander for hours on end. Nightclubs, pachinko parlors, restaurants, shops. Everything is filled to the gills with these guys roaming around in suits. It's unbelievable. They finally head for home after some preconceived notion of when it would be socially acceptable to do so.

What amused me the most was the notorious attitude toward women that pigeonholes them into subservient roles whenever possible. Many of the women stand near elevators and greet people as they enter. Resource-wasting nonsense, if you ask me. Luckily many women are working in Japanese companies nowadays. I say this because it's the women who are most likely to be multilingual and facilitate communication with Americans.

Multilingualism is not of trivial importance, a fact that the Japanese recognize. They have a joke they like telling. Q: "What do you call someone who speaks two languages?" A: Bilingual. Q: "What do you call someone who speaks three languages?" A: Trilingual. Q: "What do you call someone who only speaks one language?" A: American!

Combine ethnocentricism, old-fashioned sexism, and the general tendency of businessmen to goof-off in the streets, and you wonder why these guys are doing so well on the general ledger.

Part of the reason is the competitive spirit. While we like to imagine that the Japanese are one big happy family competing with the world as Japan Inc., the opposite is true. Companies compete fiercely with each other and enjoy seeing others fail miserably. What makes it look like Japan Inc. is a cooperation between government and business that is the opposite of what we experience in America. In the USA, business has been imagined as some sort of "enemy of the people." Government is a "watchdog." In Japan, government helps business succeed, because the government knows that business success means wealth and jobs for everyone.

The orientation is toward generating wealth and increasing production. The government helps to drum that into the minds of the masses.

ILLUSTRATION: STEPHEN SWENY

As a result, the Japanese have produced more engineers per capita than any civilized nation. We, on the other hand, produce more MBAs and lawyers than is civilized for any nation. When I was going to school the business administration students were always looked upon as the dumb kids who couldn't cut it in "real" subjects such as engineering. Now they've taken over and don't look so dumb anymore. But compared to whom?

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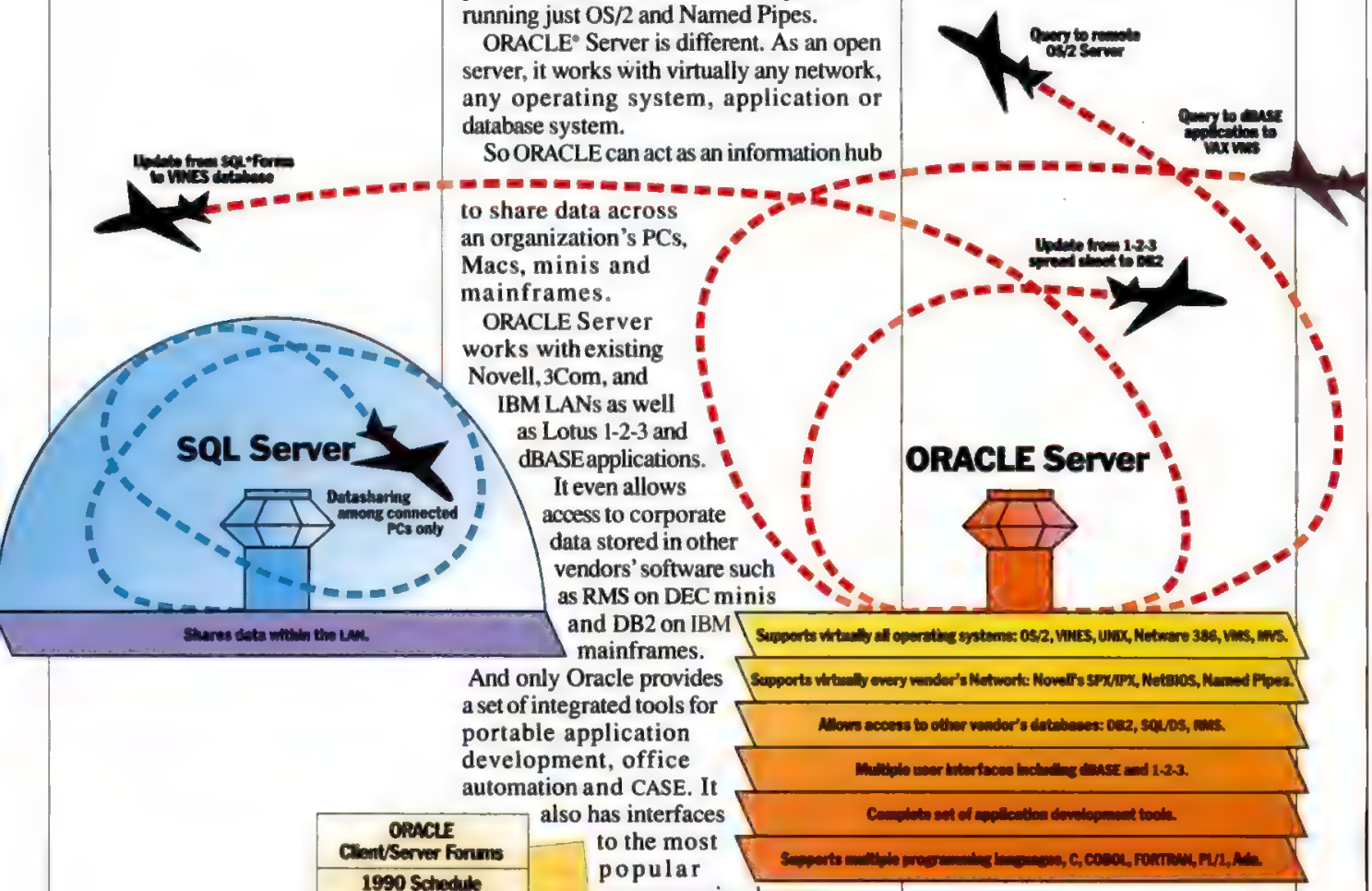

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John C.
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Inside Track

Pushing it to the Limit Dept.: The most talked about new product in Silicon Valley is the Velox ICECap module. Essentially this device is a **miniature deep freezer** designed to fit over the 486 and cool it to zero degrees centigrade. Models are also available for the 68000 family, the SPARC chips, and a few others. Cooling the chip like this allows designers to **boost chip speed.** Everex and other cloners have been playing with this device and pushing the 486 to 50 MHz. Nobody knows what to think of the idea, but they are all **amusing** themselves with revved-up machines. The comment most heard about chips pushed beyond specifications like this: "It crashes once in a while." (Velox, 2334C Walsh Ave., Santa Clara, CA 95051; ((408)) 727-6100.)

A Blast from the Past Dept.: Back in the early 1980s a company, Excalibur Technologies (2300 Buena Vista SE, Albuquerque, NM 87106; (505) 764-0081), came on the scene and went broke trying to market an unusual pattern-recognition engine that was sold as a card for the Apple II. The company went bankrupt and then reemerged over in the DEC world selling a similar (higher priced) software pattern-recognition engine that may be the **most advanced** use of **neural network technology** yet introduced. The inventor is a genius named Jim Dow and this time Excalibur Technologies is for real.

They use this system for fuzzy search text retrieval that is **unlike** anything I've ever seen. No other search engine can do searches on genuinely bad and offbeat misspellings and still find the references. **This thing does it.** The pattern-recognition engine looks at the entire binary record to create its neural-net-based index, then can do some **amazing** searches. The recognition engine derives concepts from a **Sandia Labs** n-tuples invention where the network is developed as n-duplicates in parallel then tested one against the other with the highest performer being kept, and the losers being deleted, thus making the network **self-optimizing.** All this is done on the fly.

Dow also proved to himself that most neural nets have too many **useless interconnects** and his networks are sparse when compared with what most neural network people are doing. He bases his thinking on the concept that instead of modeling neural networks on the entire mammalian nervous system, **the eye is the key.** Thinking of the eye as the progenitor of the brain itself, Dow has used the eye instead of complex synapse systems to model his neural nets. Understanding the eye and signal processing is a key, says Dow.

The future of computing lies in the development of pattern-recognition. This product is a big step in that direction. Right now the applications are big-time, like discovering oil, but soon we'll see them trickle down to everyday applications. The product is sold mostly through Digital Sales Reps. Keep an eye out for them.

Genuinely Interesting Software Dept.: The hot thing happening in Hollywood is the **million-dollar** screenplay. If you dream of striking it rich with a great screenplay, you'll **get nowhere fast** unless you show an agent or producer a screenplay done in a very rigid format. This way you'll look like you know what you're doing. For a decade, Screenplay Systems, (348 E. Olive Ave., #F, Burbank, CA 91502; (818) 843-6557) has been marketing *Scriptor* to the professionals. You write the screenplay with a word processor using a simple structure and then the *Scriptor* program compiles the text into **a perfect script.** Well, perfectly formatted at least. It costs $295 and pays for itself with the first $100,000 screenplay you sell. When you get into those millions you won't even care.

> "One Canon USA customer insists on being supplied with a way to connect his dictophone with his printer for hard copy of his musings."

If you need help on that screenplay give the **screenplay writers' BBS** a call and get conferencing. The BBS number (when it's up) is (213) 459-8993. The BBS is run by John Truby, a screen consultant who is **a legend** in the Hollywood writers' circles because he's dissected successful plots and stories in new and fascinating ways.

Memo from editor Gus Venditto Dept.: "Here's one for your 'stupid questions' series. Credit goes to Steve Tyson at Canon USA. One of its customers insists on being supplied with a way to connect his dictaphone with his printer so he can have hard copy of his musings."

Then there was the one about the butcher who backed into a **meat grinder** and got a little behind in his work.

While on the Subject of Humorous Images Dept.: Here's an "everyone is trying to get into the act" item. Apparently, within the year, **Japan's Nippon Steel Corp.** will enter the personal computer scene by announcing a **laptop computer.** According to a Japanese news report, "The move comes as another step among major Japanese steel makers toward diversifying their businesses, making Nippon Steel the first major Japanese steel maker to advance into the fast-growing, but highly competitive market."

Who are these guys kidding? What are they going to name these machines? The Ingot 2000 comes to mind. How about the Rebar XL or the **Pig Iron Portable?** When are Japanese hotel chains going to enter the PC market? How about the **Tokyo Fish Market** making a PC? They could announce a Turbot XT! (I do these jokes just for the Halibut!) ■

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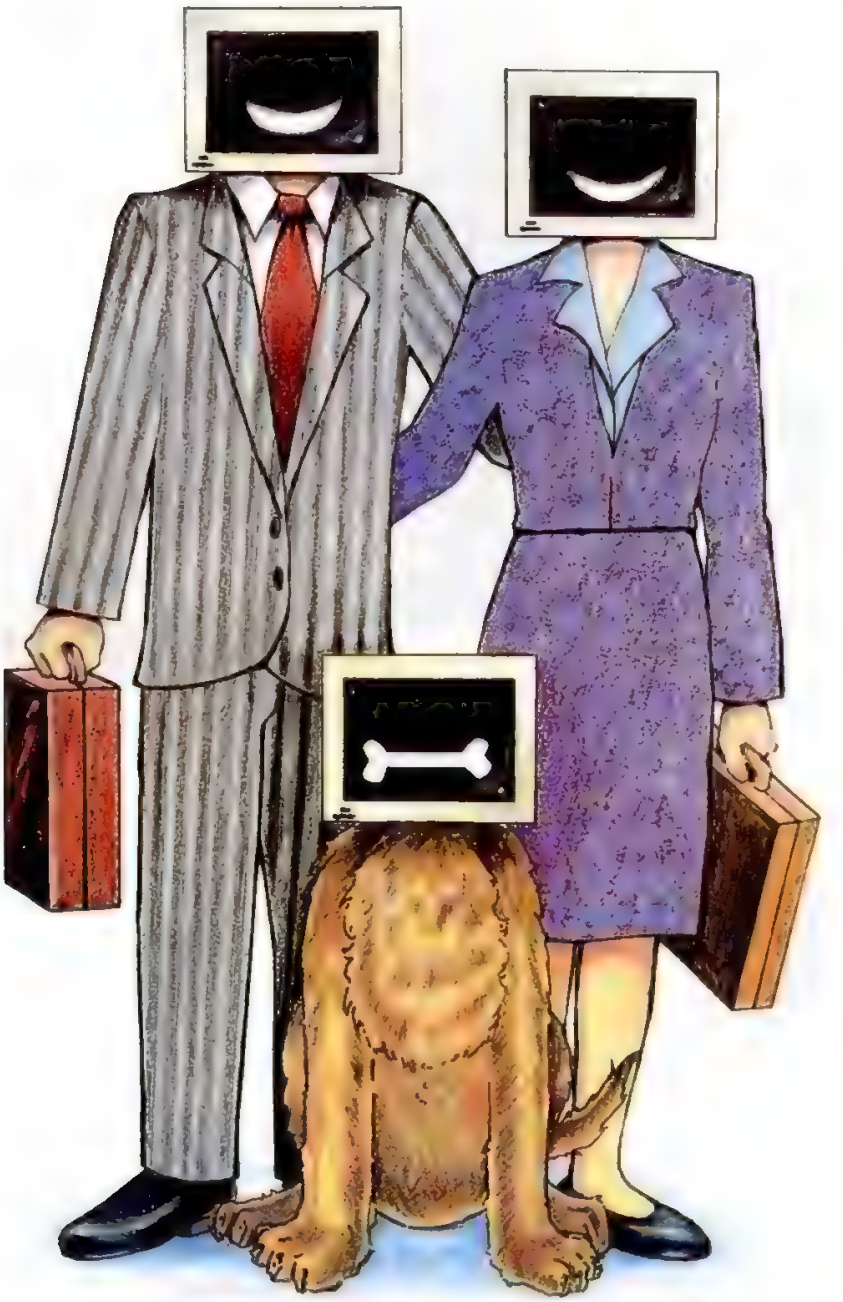

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Jim Seymour

The "Slate PC" Wave Is About To Break

For those outside the world of traditional keyboard-based PCs, the surf's up on a new wave of computing.

Get ready for the deluge. Over the next year, you're going to be swept under a *tsunami* of rhetoric about the new class of "slate PCs." That name may not hold—"pen PCs" is catchy, too—but by whatever name, these computers are going to draw a great deal of hype, breast-beating, and utter nonsense. Not only in the computer press, but also in business, technology, and pop-science magazines, and in the daily press.

That coverage will converge around two opposite and equally ill-informed views: (1) these slate PCs are the greatest computers ever, and will change how we live and work; and (2) no, no, a thousand times no; they're a joke and a fraud.

No one ever said figuring out the PC market was easy, right?

Before that wave of media hysteria hits the beach, let's take a calm, intelligent look at these new machines: how they work, who constitutes their intended market, and whether you're a likely buyer.

A lot of the confusion about this market-to-be arises because most of these machines can accept handwritten input. Using a stylus, the user writes on a pad; the data is read, interpreted, and entered by the computer as a series of ASCII characters.

Handwriting recognition still hasn't reached the stage where we can scribble typically sloppy handwriting and have the computer extract the alphabet from our chicken scratch. So at least in the beginning, slate PC users will need to print block letters or discrete upper- and lower-case characters.

The focus on handwriting recognition, and its current limitations, fires up the "No, no, a thousand times no!" anti-slate troops, who point out that these things are never going to replace regular PCs, including laptops, until they can turn scribbled, nearly illegible handwriting into clean input. And even with that, they add, slate PCs will never really replace keyboard-based portables, since people aren't *that* afraid to type.

Which is where the great misunderstanding of slate PCs begins.

"These things" are not *meant* to replace standard PCs—desktops, laptops, or palmtops, nor are they meant as keyboard substitutes for PC users who enter text and numbers, then manipulate that input in word processing, spreadsheet, and other mainstream business-PC functions.

THE WORKPLACE WITHOUT PCs

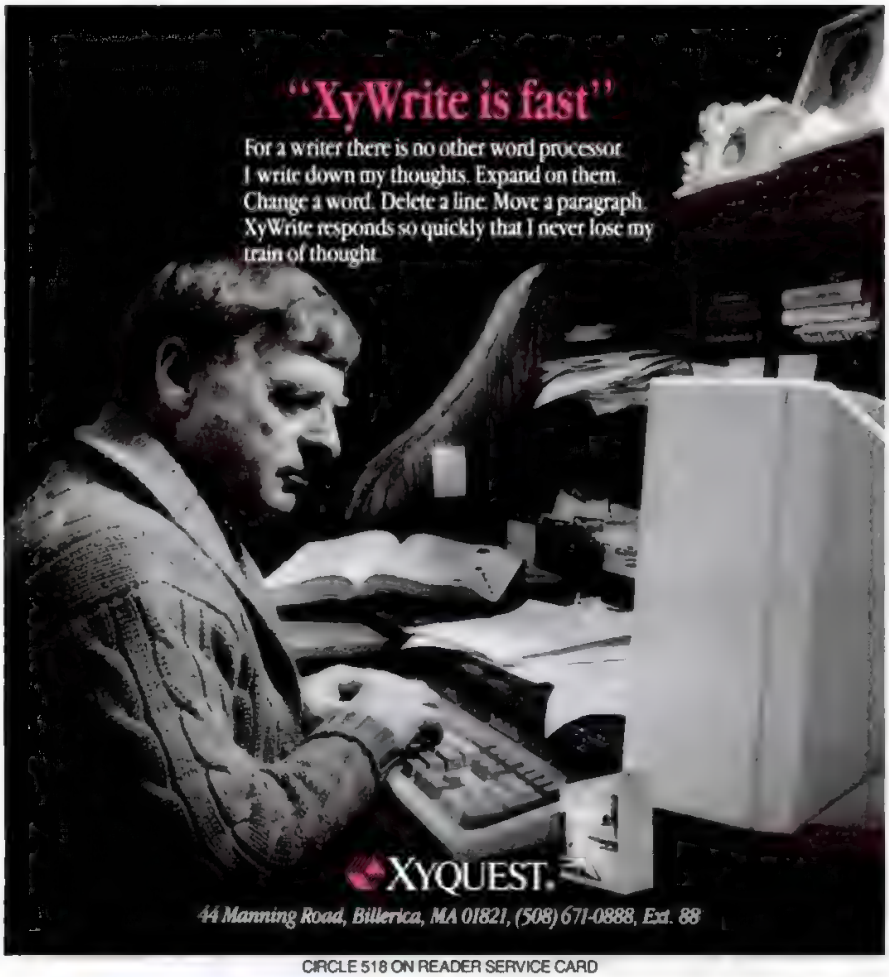
Slate PCs are after the other hemisphere of the workplace—those people who aren't PC users today, and are likely *never* to be users of PCs in their present form. These people don't sit at desks and write letters, draft reports, analyze pricing strategies, send out bagfuls of mail-merged letters, or add new records to shared databases.

Instead, they drive trucks, man loading docks, count inventory, put bread out on grocery shelves, deliver FedEx packages, fix the PCs at our desks, stock Fritos racks, write traffic tickets, read electric meters, nurse us back to health, repair aircraft engines, take orders in the field, and perform 10,000 other vital functions in our economy. Most but not all are

ILLUSTRATION: STEPHEN SWENY

blue-collar workers; there are few "gold-collar" workers among them. They make an incredible contribution to our lives and to this country's economy.

They're not PC users now, and likely will never use even the slickest desktops or laptops. Palmtops might be a possibility for them, but since their use of a computer doesn't focus on keyboard entry, the space given to the keyboard on palmtops—and the prevailing vision of



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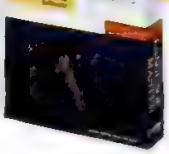

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palmtops as highly miniaturized desktop PCs—make palmtops a poor fit for their needs.

When the naysayers on slate PCs finally stumble onto this fact, their response is often like that of Emily Litella on "Saturday Night Live": a long pause while the shock sets in, then "Oh, never mind."

If the naysayers persist, very likely they launch into a closet-elitist wheeze about how these aren't *real* PCs after all, and how they don't know that much about the needs of Those People.

I embrace the idea of sweeping millions of nonoffice workers into the fold of those who use computers. It will enlarge their lives and their roles in *my* life. And I wish both slate PCs and those they are built to serve got a little more respect.

A CUSTOM FIT

Slate PCs are perfect for highly customized software which relies on the user checking off boxes, or calling up scrolling lists on-screen and then tapping the right entries to select them. It's much faster and more accurate to pick items from lists with stylus-taps than to remember and enter product codes. To indicate quantities or dates, most slate PC users will simply tap the appropriate number from an appropriate range of digits shown on-screen.

There won't *be* much handwriting to recognize; what little alphanumeric input is needed will hardly be burdensome.

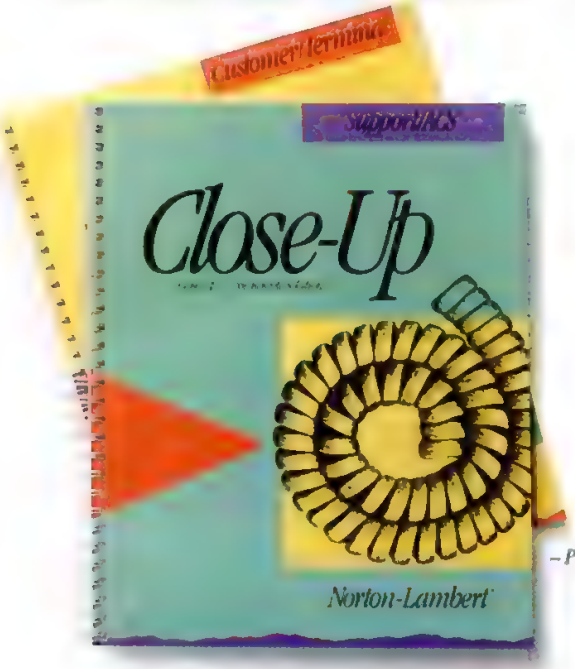
ARDIS, the Advanced Radio Data Information Service assembled nationwide by Motorola and IBM, is the last step in tying these slate PCs into our wide area networks and information systems.

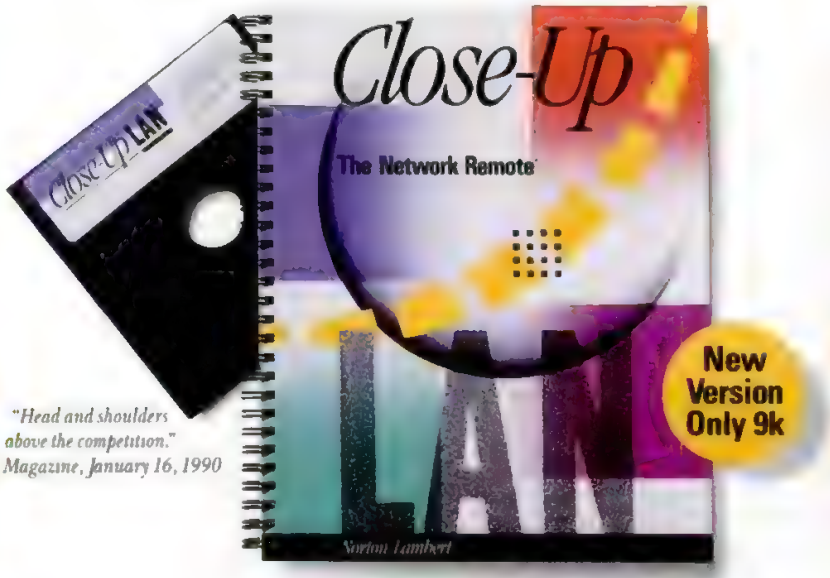
Sony, GRiD, Go, and Momenta are leading the development of slate PCs and software. Technical innovation will abound; most of these machines will run operating systems other than DOS. (I *hope* they do, because otherwise how we see their role and functions will be bounded by how we have learned to apply DOS machines in the office.)

Alvin Toffler, author of *Future Shock*, wrote years ago that in the coming Third Wave of technological change, some will "surf" the Third Wave, adopting the new ways; while others, bound to the past, will be swept under. The slate PCs market will be a highly visible example of that principle at work. ■

"Leader of the Pack"

– PC Magazine, October 31, 1989





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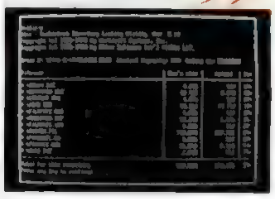

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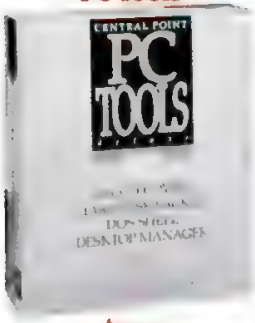

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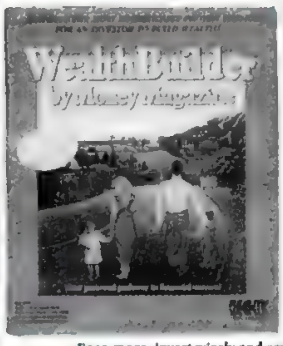

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William F.
Zachmann

Cost-Justifying Computers

Black magic and wishful thinking won't make your manager approve your next new computer purchase. But a clear analysis and presentation of the benefits will.

Cost-justifying traditional mainframe and minicomputer systems has long been as much art as science. Cost-justifying *personal* computers, however, seems to be an even more daunting task. Based upon pronouncements made by some analysts, one might be tempted to believe it to be beyond the pale of science, deep in the realm of the blackest of arts.

Consider, for example, the allegation that the billions spent on personal computer hardware and software over the past decade have not added a whit to white-collar productivity. Consider too, the common claim that personal computers sit idle most of the time as wasted resources. Consider further, the complete abdication of responsibility by some industry gurus who believe that personal computers need no justification at all; PCs should be taken for granted as necessary like chairs, desks, and telephones.

If these claims concerning lack of productivity and valid cost justification are not challenged effectively, the computer industry will be in a sorry state in the years ahead. What's more, all the newer, more capable graphical environments like OS/2, *Windows, OSF Motif,* and *Open Look* will fall far short of success. For all of them, even *Windows,* require substantial investments in more powerful personal computers before they are widely accepted and used.

A THREE-STEP PLAN

What will be the financial return on money spent for more powerful computers? Most readers will agree that persistent questions are necessary, and that these questions require good answers. Especially when chillier winds blow through the economy, those who can't show a clear cost justification for new computers aren't likely to get them.

The first requirement for effective cost justification, therefore, is to admit to its necessity. Gee whiz technology and nifty multimedia demonstrations are no substitute for sensible arguments demonstrating a real return on investment. Getting the right executive excited about technology may be enough to get a signature on the purchase order, but a convincing cost justification is far more effective.

The second requirement is that there be a real benefit to the business from the investment. That may seem both obvious and trivial. It is neither. One of the reasons why cost justification so often involves black magic is that in many cases the costs are not justified. Not every opportunity to buy nifty new technology is justifiable.

It is not uncommon for proposed computer acquisitions to be ill-conceived. *Others* may be motivated more by a desire to get some nifty new toys than by a real business need. We are always justified in *our* requests for new hardware! Aren't we? Well, perhaps so. But maybe we ought to consider the possibility that we are not, at least not all of the time.

True cost justification, however, is downright impossible if no real business gains exist to offset the costs! That's where the black magic comes into play. Under these circumstances, cost justification becomes an arcane ritual to prove something that isn't really so.

Engaging in such rituals benefits neither the practitioner nor the enterprise. It may give those who want technology for its own sake some new toys, but at the expense of the enterprise's productivity and profitability.

ILLUSTRATION: STEPHEN SWENY

The third requirement for effective cost justification is to show, clearly, the benefits that offset the cost of new hardware and software. This requirement isn't nearly as difficult as it seems, *provided* that the first two requirements are met.

Much hand wringing over the supposed

difficulty in cost-justifying PCs is a result of ignoring the first two requirements. If one acknowledges that cost justification is necessary, and determines that there are real, not imagined, benefits, then it should be possible to present those benefits in a convincing manner.

Having said this, however, it is necessary to acknowledge two further potential obstacles: the need for quantification and computer-averse management. The former is nearly always surmountable. The second more frequently is not.

If those managers who allocate money for equipment are inherently averse to computers, then getting a purchase order approved can be real challenge, to say the least. That is why I've emphasized so strongly the first two requirements for effective cost justification. For this challenge will not be met by avoiding cost justification or by trying to justify costs that are not justifiable.

ZACHMANN'S LAW

In the early 1980s I first propounded (and slyly attributed to my grandfather) a timeless management principle known as Zachmann's Law: *In decision making within organizations, the factors that bear upon a decision tend to be weighed in direct proportion to the ease with which they can be quantified or apparently quantified.*

Zachmann's Law has two (unfortunate) corollaries: *The more important the decision, the less likely the critical factors are to be accurately quantifiable;* and *the more important the factor, the less likely it is to be accurately quantifiable.*

The quantification issue in cost justification is unavoidable. Costs are easily quantified; however, quantifying benefits is usually more difficult. As a result there is a tendency to weigh the costs more heavily than the benefits.

The most straightforward way to quantify the benefits of investment in technology is to clearly demonstrate direct offsetting savings, such as reductions in personnel, or at least in staff growth in affected departments. Another good way is to compare the costs needed to accomplish particular tasks given professional labor rates. It isn't hard to show that a $50-an-hour professional can do more spreadsheets or write more reports with a computer than without one. There is not, however, some generic panacea that justifies costs in every context, nor will there ever be one. It is necessary to address the specifics of a given organization.

True, there will be instances where strict quantification of offsetting benefits will be more difficult, even when real benefits are present. Reasonable management, however, will often be persuaded to accept a certain element of "soft" benefits. And even computer-averse management will have a hard time ignoring an effective presentation of well-reasoned "hard" quantifiable benefits.

In any case, the real key is not to waste time bemoaning the difficulties of cost justification, trying to avoid it, and looking for some magical reason to buy nifty new stuff. One's energy and creativity are much better spent ensuring that the real benefits are there and then quantifying and presenting them effectively. ■

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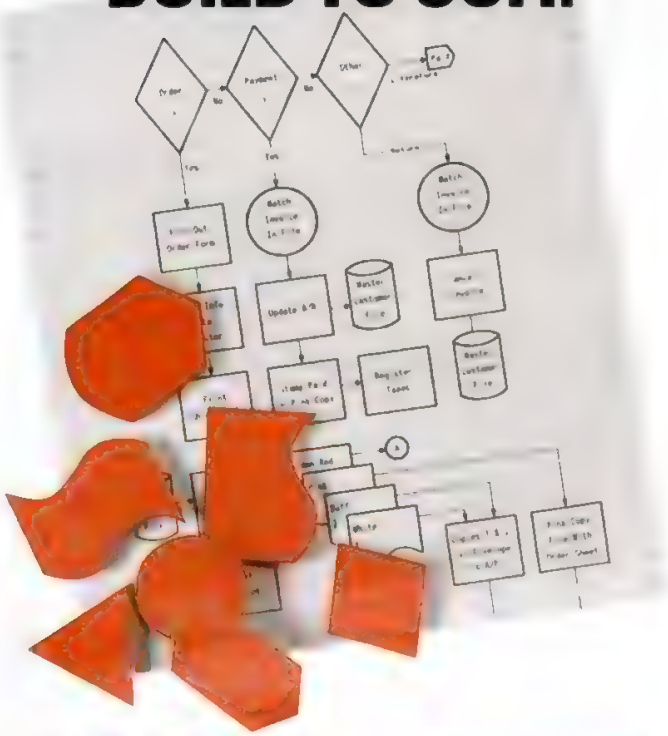

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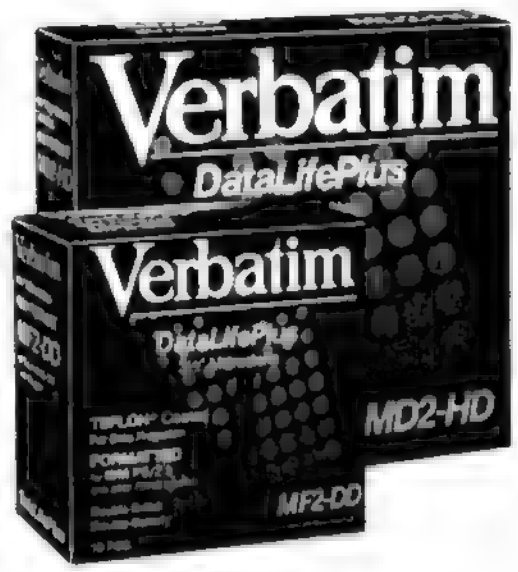

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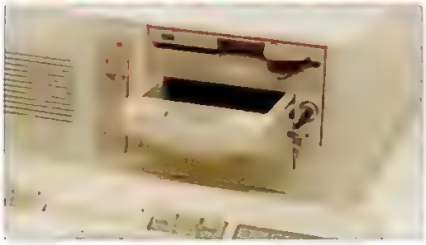

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Here's the short story.

POWER PORTABLES

the next wave

by Bill Howard

The 386SX supplants the 286 as the chip of choice for power portables. PC Labs tests 9 fire-breathing battery-powered SX models, a new 386 machine, and 4 notebooks that use the 286 processor—the rising star in the low-end laptop arena.

Faster, better, smarter—the newest round of portable PCs stand superior in every way to the state of the art of just 6 or 12 months ago. Two classes of machines stand out among today's portables:

- **Mainstream portables.** The 80386SX chip is supplanting the 80286 in the engine room. VGA displays are a given, weights are edging down (but still closer to 15 pounds than 10), and prices are competitive with the previous generation. Expect to pay $3,000 to $4,000 (street price) for this kind of power. Two years ago, we repeatedly said there's no reason to buy anything other than a 386 for your desktop. Now that SX portables are part of the 386 family, there's no reason to buy anything less than a 386. Period.

PHOTOGRAPHY: JOHN WILKES

■ **Notebook portables.** The 8088/8086 notetaker of choice now has a 286 processor (with SX variants en route within six months), an ultralight hard disk, and a VGA display. Compromises have been reduced but not eliminated. Some models can be had for as little as $2,000 street price; the best are around $3,000.

Six months ago, *PC Magazine* devoted an issue to reviews of all the portable PCs we could find on the market: "30 do-anything 386s, 36 workhorse 286s, and 7 go-anywhere notebook PCs" (March 13, 1990). Since we reviewed those 73, more than three dozen new portables have appeared. Here, we review all 14 available new models, including battery-powered 386SX portables from Arima, Compaq, Data General, Epson, GRiD Systems, Impulse Systems, ITC, Toshiba, and Twinhead, as well as Zenith's new 386 TurbosPort. We also review 4 286-powered notebook PCs weighing no more than 8.5 pounds, from Compaq, Sharp, Texas Instruments, and Toshiba. And we describe the most important new machines, from Airis, NEC, and others, that are shipping a few weeks too late to make our deadlines.

TRENDS

If you're in the market for a mainstream portable, you'll find that the majority are still based on 286 CPUs. But there's no reason for you to stick with yesterday's technology. The 386SX provides superior performance for just a few dollars more. A 16-MHz 386SX portable system may cost a manufacturer $50 more to make than a 12-MHz 286. Based on the rule that manufacturing costs are passed along fourfold to the buyer, you're talking about an extra $200, or 3 percent of the $6,000 list price for a portable. That's peanuts.

Today's better portable also provides a 40MB or bigger hard disk with sub-30-millisecond access time, quick-change batteries, sophisticated power-down and sleep modes, and enough memory capacity to multitask several applications. You'll have a range of connectivity options and modems with competent error correction. You're likely to be offered—and you probably will buy—a $1,000 docking station option that automatically snaps your portable into action in the office or at home and connects you to a LAN and an external monitor.

In other words, today's portable has everything you'd expect from a desktop PC. It just costs more. Expect to pay a quarter to a third more, or an extra $1,000, for a leading-edge, go-anywhere SX portable, as opposed to a similarly equipped desktop system from the same vendor.

PACE OF TECHNOLOGY

Consider how the state of the art has evolved among battery-powered portables and notebook-style laptop computers. For the past three years, the best portables have weighed 15 pounds and cost $6,000 to $7,000 list ($3,500 to $4,500 street price), but during that period, processor performance, disk capacity, and video resolution have improved by 50 to 100 percent.

If you're in the market for a portable, there's no reason for you to stick with yesterday's technology. The 386SX provides superior performance for just a few dollars more.

In 1988, the power user's portable was the seminal Zenith SupersPort 286, with a 12-MHz 286 processor, a maximum capacity of 2MB RAM, 20MB and 40MB hard disk options, and a CGA display. In 1989, the portable to beat was the Compaq SLT/286—also a 12-MHz 286, but with nearly 5MB memory capacity, along with 20MB and 40MB hard disk options, VGA display, detachable keyboard, and sleep mode. At the beginning of 1990 it was the Toshiba T3100SX, which ushered in the 16-MHz 386SX chip on portables, with a lightning-fast gas plasma display that didn't drain your batteries in 30 minutes.

Now the leader's mantle belongs to the Compaq SLT 386s/20, the first portable with the 20-MHz version of Intel's 386SX chip. The *standard* memory capacity is now 2MB, not just 1MB. The hard disk choices are 60MB and 120MB. Yet the price remains a constant: $6,799 for the 60MB model.

What's in store for next year? Among this class of machines, look for a shift from 16-MHz to 20-MHz SX processors, bigger hard disks, a price erosion of from $500 to $1,000, and weight reductions that will put the leading-edge machines closer to 10 pounds than 15. You'll also see a few more color portables for the well-heeled. Right now, color on pioneering machines from NEC and Sharp adds about $2,500 to their price, and frankly, the color isn't breathtaking. In addition, the feature remains an AC-only option. Real, affordable color may have more to do with 1992–93 technology than 1991. (See the sidebar "A New Twist for Laptops.")

NOTES ON NOTEBOOKS

The first serious DOS-based notebook PC was the Toshiba T1000 in 1987. When every other portable weighed at least 10 pounds, the T1000's 6 pounds was a revelation. This minimalist machine, with its pokey 4.77-MHz 80C88 CPU, a single 720K floppy disk drive, and a nonilluminated 3- by 10-inch CGA display, cost $1,748 with a 768K RAM disk card. Still in production, you can find it today at a street price of less than $600.

In October 1988, NEC unveiled a technological tour de force, the diskless UltraLite: 4.4 pounds (now down to 4.1), with a 9.83-MHz V-30 (8086-compatible) processor, a 2MB RAM disk, an illuminated 4- by 8-inch display, a ROM card slot, a built-in 2,400-bps modem, and a 1.5- by 12- by 8-inch size, for $2,999. But compromises and tradeoffs made the UltraLite more of an image leader than a sales leader. To transfer files to other PCs, you needed to buy and connect an external floppy disk drive or use a cantankerous file-transfer program. If you left the UltraLite unplugged for more than a week, you risked losing your RAM disk files as the battery drained.

In 1989, Toshiba modernized the T1000 concept with a bigger, backlit screen and a faster 9.54-MHz 80C86 processor. The emerging machine, the T1000SE, weighs 6 pounds and costs $1,699. But it was Compaq that lit a fire under the notebook market last October with the Citizen-built LTE and LTE/286. Scaled exactly to the size of a stack of notebook paper—2 by 11 by 8.5 inches—and weighing 7 pounds, the LTE provides two disk drives to Toshiba's one.

Currently, the state of the art is represented by the new Sharp PC-6220. Measuring 1.5 by 11 by 8.5 inches and weighing 4.5 pounds, it uses a 12-MHz 286 and includes a dazzling 6- by 8-inch VGA screen that displays 16 shades of gray. The Sharp (and the identical Texas Instruments TravelMate 2000) has just one drive, a 20MB hard disk. The floppy disk drive is a $299 slide-on option.

Among makers of notebook PCs, opinion varies sharply as to what features you must include—and how much you can leave out without annoying the customer. NEC, Sharp, and Toshiba believe there is a market for ultrasmall, ultralight machines with single drives (or no drives other than nonvolatile RAM disks). Compaq represents the opposite camp, saying that customers won't settle for a portable without a floppy disk drive.

If market share is the judge, Compaq knows best. Buoyed by the phenomenal success of the sales-leader LTE and LTE/286, Compaq today controls (by one industry estimate) 60 percent of the market for DOS portables, against 20 percent for Toshiba and a bit under 10 percent for NEC. That represents major progress for Compaq, treading water for Toshiba, downtimes for NEC, and "lo, how the mighty have fallen" for Zenith, which used to control more than 25 percent of the market. Other major market shareholders: IBM, Sharp, and Tandy/GRiD.

PALM-SIZE PCs

If you want a system even smaller than the Sharp PC-6220 at 4.5 pounds, you're in the market for a hand-held or "palmtop" DOS work-along like the Casio B.O.S.S., the Atari Portfolio, or the Sharp Wizard. These provide adequate functionality for

EDITOR'S CHOICE

- PC-6220 (80286)
- TravelMate 2000 (80286)

- Compaq SLT 386s/20 (80386SX)
- Toshiba T3100SX (80386SX)

Four products stand out among the 14 battery-powered notebook and portable PCs we reviewed. Of the four 12-MHz 80286 notebooks, the Sharp PC-6200 and Texas Instruments' TravelMate 2000 represent significant advances in truly portable computing.

Among the 15-pound 386SX-based portables, the Compaq SLT 386s/20 packs the most power yet in a battery-operated PC, and the Toshiba T3100SX, meanwhile, has the best display.

The Sharp and TI notebooks are marvels of efficiency, with many of the same specs: a 20MB hard disk, an 8- by 6-inch VGA display with 16 shades of gray, a weight of 4.4 pounds, an 11- by 8.5-inch footprint. They suffer from one significant design compromise: no internal floppy disk drive. We strongly recommend the $299 external drive option, which clips onto the right side and adds 1.4 pounds. The machine is also replete with options, such as a fax/data modem, math coprocessor, and a five-hour battery pack, if you don't mind the extra weight. The Texas Instruments version has a different case and utilities, but otherwise it's the same package.

If you must have both a hard disk and a floppy disk drive in your notebook PC, you'll be satisfied with either the Compaq LTE/286 or the Toshiba T1200XE. The Compaq is smaller and lighter and offers a 40MB hard disk in place of Toshiba's 20MB, but the small CGA screen is ill proportioned, and the cursor-key layout is the worst among all portables reviewed. While Toshiba strains the upper boundary of notebook computing at 8.5 pounds, you do get an 8- by 5-inch CGA screen and eight cursor keys. Both of these units deserve honorable mention.

For overall performance, Compaq's rugged SLT 386s/20 stands alone, thanks to the 20-MHz SX processor and 4K memory cache, 60MB hard disk (with 120MB optional), and detachable keyboard, as well as a sophisticated error-correcting modem as an option. As on the LTE/286, the quality of the 8- by 6-inch VGA display is merely adequate, which is disappointing for an otherwise impeccable machine. If you opt for either of these Compaq machines (the LTE/286 is currently the best-selling portable), you can expect to pay several hundred dollars more than for the next-most-expensive portable.

The dazzling 8- by 6-inch, 16-gray-scale gas plasma display on the 16-MHz Toshiba T3100SX makes this the best demo machine, especially since you can run the display and a monitor simultaneously. In addition, Toshiba's excellent power conservation features extend battery life beyond three hours. We can reasonably expect Toshiba to introduce a 20-MHz SX version in short order to keep up with Compaq.

As for the Editor's Choices in our previous portable roundup (March 13, 1990), we're still comfortable with the 386 and 386SX choices: the Dell 316LT, an affordable battery-powered 16-MHz SX unit; the Dolch P.A.C. 386-25C, a husky, speedy 25-MHz AC-only lunchbox; the IBM PS/2 Model P70 386, a 20-MHz AC-only lunchbox; the Toshiba T3100 SX, with its 16-MHz processor; and the Toshiba T5200/100, a 20-MHz AC-only clamshell portable.

We chose two 8088/8086-based notebook units in March and conditionally continue to recommend them. The condition: they're for light-duty tasks. If you can live without a hard drive or floppy disk drive, the 4-pound NEC UltraLite is an attractive machine, with its price dropped by $1,000 to $1,999, and the 6-pound, single-floppy-drive Toshiba T1000SE also bears investigation.

Five 286-based battery-powered portables were Editor's Choices in March, but we now recommend that you choose a 386SX.

If you do opt for a 286, watch for price reductions, rebates, and closeouts, which can save you an extra $500.

many users. Hint: Look for QWERTY keyboards. ABCD keyboards just don't cut it.

Another evolving area in ultralight, ultraportable computing is the category called (pick a term) notepad, slate, workslate, or pen PC computer. See Jim Seymour's column in this issue ("The 'Slate PC' Wave Is About To Break" for a discussion of the market potential for the hardware and technology being developed by Data Entry Systems, GRiD Systems, Go, IBM, MicroSlate, Microsoft, Momenta, Slate, Sony, and SuperScript.

Basically, to build a slate PC, you pour computer circuitry into an Etch-A-Sketch, add a writing stylus, and compose beyond-state-of-the-art character-recognition software. Many of these systems will be non-DOS machines intended for specialized applications. They're most likely to complement PCs and laptops, not compete with them. Slates will be used by service-industry personnel who now work with pencil and paper or with expensive hand-held terminals. A second, perhaps sexier market will be for executive notepads.

Be warned: handwriting recognition is still lousy except for block characters. But so what? Many applications will involve choosing from lists presented on-screen; there'll be little handwriting involved. What's coming along more rapidly is shape recognition. Draw something that looks like a dunce cap when your slate PC is in architectural mode and your slate will

MNP, CCITT, V-DOT-22-BISS, AND LAP-M: Won't Somebody *Please* Speak English?

Understanding the industry jargon will help you get the right modem for your portable PC.

by Bill Howard

Progress is a mixed blessing. Updated technology in communications hardware means fewer errors, increased throughput, and more terminology to comprehend. Here's a crash course in modem terminology: all you need to know to make an informed buying judgment now that you have multiple choices in laptop modems.

■ **Speed.** CCITT V.22bis, usually shortened to V.22bis and pronounced "V-dot-22-biss," means your modem runs at 2,400 bits per second (bps) or 2,400 baud. V.32 means 9,600 bps. Bell 212A and V.22 (with no bis) are 1,200-bps standards.

Suggestion: Say 2,400 bps, not V-dot-22-biss. Everyone knows what you mean. Technically, the baud rate is not the same as bits per second, but the only people who lose sleep over this are equally horrified to see 1 kilobyte rounded off to 1,000 bytes. Rule of thumb: To tell how fast the modem runs, divide the bps by 10. A 2,400-baud (sorry, 2,400-bps) modem runs at about 240 characters per second.

■ **Data compression.** Squeeze the volume out of your transmission and you double or quadruple the effective speed. MNP 5 is today's standard (up to 2:1 compression), and CCITT V.42bis (4:1) is where it's headed. Modems can have both; it's not an either/or situation.

By the way, *MNP* stands for *Microcom Networking Protocol. CCITT* is the acronym for a long French phrase that means "International Phone Standards Committee."

■ **Error correction.** Modems with no error correction are the most common, but MNP 4 is where it's at, and V.42 is the future. The main V.42 error correction protocol is called LAP-M; V.42 also includes MNP 4 error correction. MNP 5 is sometimes described as error correction ("I've got an MNP 5 error-correcting modem") because MNP 5 (data compression) includes lower MNP classes like MNP 4 (error correction).

Buying hint: A modem may be described as V.42 compatible or V.42 compliant. The terms sound the same but V.42 compliant is better.

■ **Fax.** Some modems also support Group III fax, which is what the fax machine in your office understands. The fax terminology is called V.29, but just say Group III.

Some modem fax devices are outbound only, which is no great loss; incoming faxes devour disk space, and viewing them on a computer screen is an exercise in frustration. The sane choice: Use a normal modem and public e-mail services (CompuServe, MCI, Western Union) to send text-only faxes on the road. Have inbound faxes sent to a fax machine at your hotel or remote work site.

CARRY-ALONG COMMUNICATIONS

The most common modem on a portable today is an asynchronous Hayes-compatible 2,400-bps (V.22bis) unit with fallback to 1,200/300 bps, no error correction, and no data compression; it works pretty well most of the time. If you're buying one, however, you should get at least a 2,400-bps modem with MNP 5, which is supported by public e-mail services and corporate dial-up LANs. Better yet, get one with MNP 5 (compression), plus V.42bis (compression) and V.42 (correction). Your new modem will automatically negotiate with any other modem and use all the protocols available at both ends; you don't lift a finger.

Among the portables reviewed here, the best modem is available for the Compaq SLT 386s/20: $599 list for V.22bis (2,400 bps); V.42bis and MNP 5 (data compression); V.42, LAP-M, and MNP 2–4 (error correction); various 300- and 1,200-bps fallback modes; and a synchronous mode that lets you talk to mainframes. The GRiD 1450sx also has a modem that understands correction and compression better than most.

If your portable doesn't have the modem you want, look into the portable external modems and fax boards from Touchbase Systems ((516) 261-0423) and The Complete PC ((408) 434-0145). To extend the life of your plain-vanilla modem, you can add MNP 4 and 5 as a software layer with MTE communications software ($79 from MagicSoft, (708) 953-2374). ■

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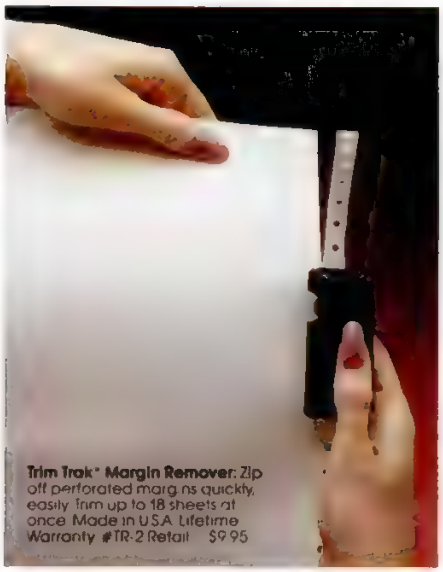

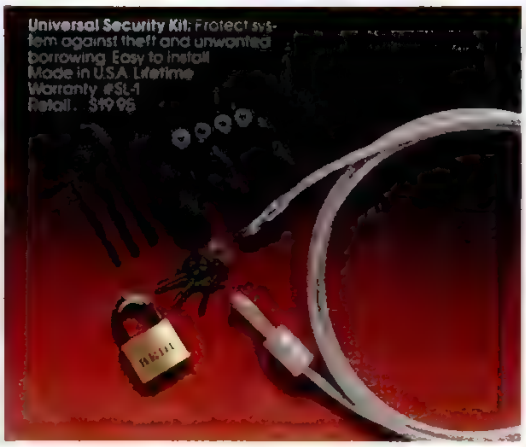

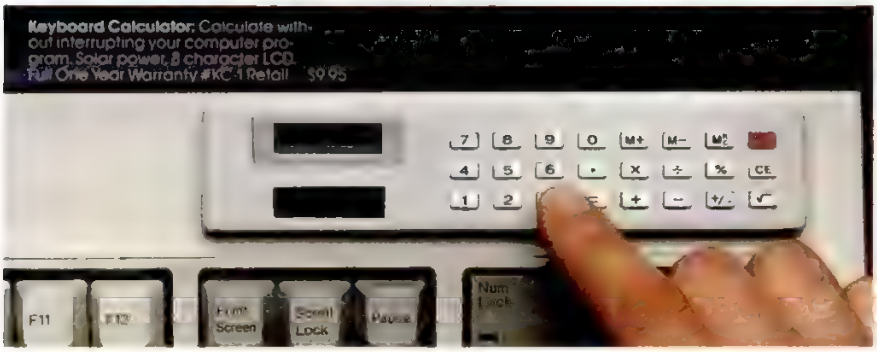

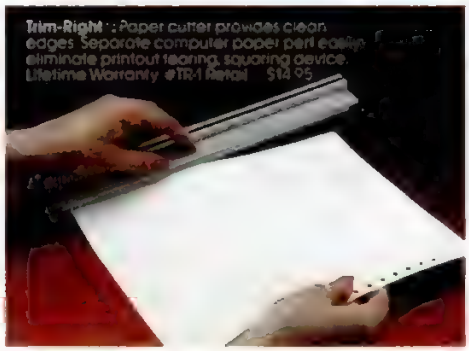

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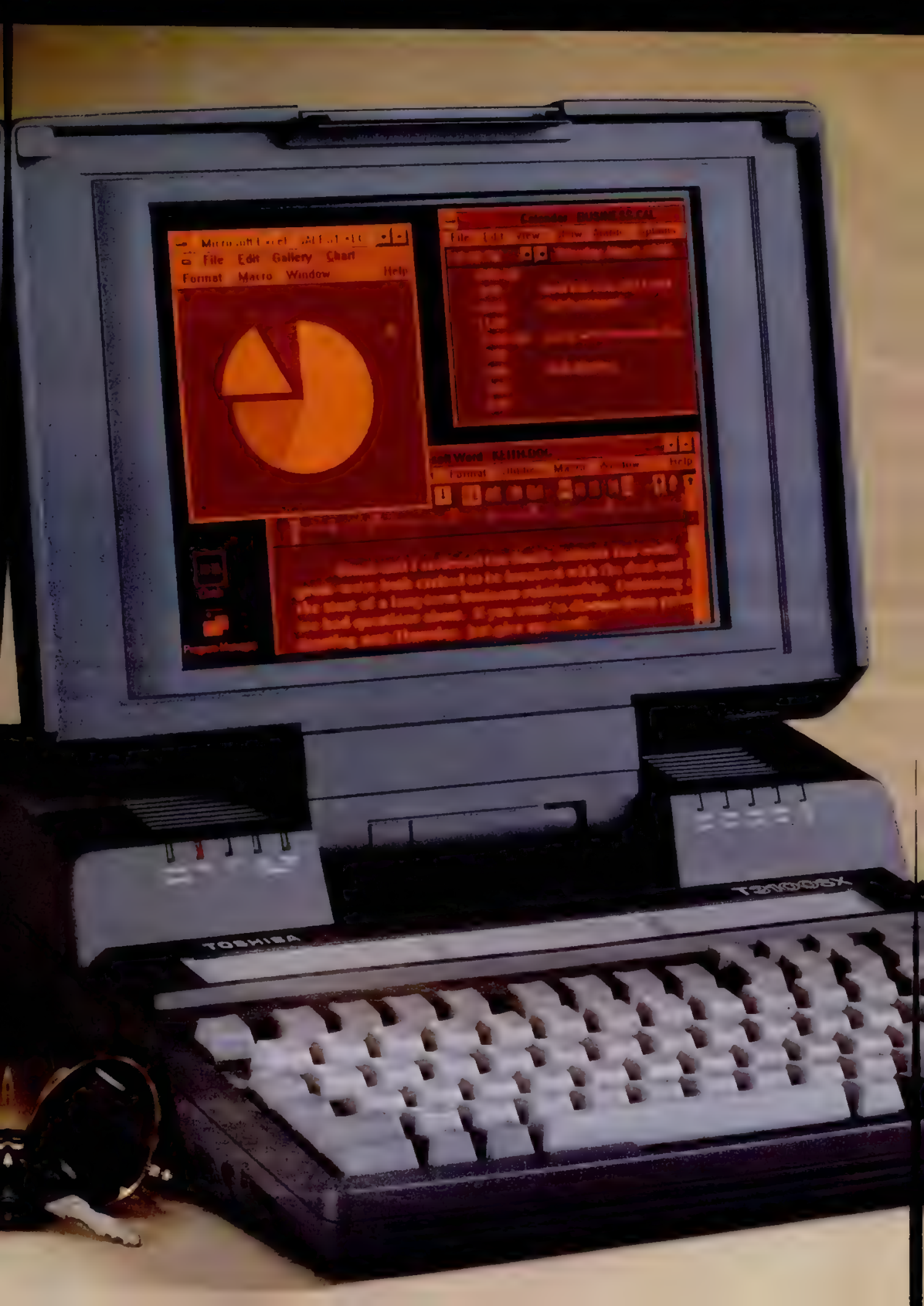
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KEY FEATURES

Here's a summary of features to consider as you read the reviews and plot your buying plans. The features table details the specifics of each portable and notebook-style unit.

- **Video.** Settle for nothing less than VGA. Double-scan CGA (640 by 400 pixels) on Toshiba's notebooks is a poor second choice.

You can't overstate the importance of multiple gray scales for crisp images; the best video controllers display 16 shades of gray. Sharp is a leader here.

Arguably the best display among these machines is the Toshiba T3100SX's 6- by 8-inch low-power gas plasma display. Toshiba and Twinhead let you run an external display without disabling the screen on your portable, which is great if you use your system to run demos. To save space, some notebook portables have no provisions for connecting an external monitor. You decide whether that's a problem.

- **Size and weight.** Don't worry too much about one or two extra pounds or inches among the portables. The difference is not all that significant.

Among notebook machines, the smaller you go, the greater the compromises. Compaq's 8.5- by 11-inch LTE/286 has a smallish screen and four awkwardly placed cursor keys; Toshiba's 11- by 12-inch T1200XE provides a bigger screen and eight properly placed cursor keys. To get its PC-6220 down to 4.5 pounds, Sharp jettisoned the floppy disk drive and made some of the I/O connectors nonstandard.

- **Mass storage.** The 10-ounce, 2.5-inch hard disks from Conner Peripherals, JVC, and PrairieTek constitute a core technology found in the current generation of notebook PCs. These disk drives are limited to 20MB now, with 40MB expected at year's end. (That's why you can't get 40MB on the smallest notebook PCs right now, if they use single-platter 2.5-inch hard disks; this is not a conspiracy on the part of the makers.) They are also fast, typically with an access time of 25 milliseconds. Dual-platter 2.5-inchers do provide 40MB, with 80MB en route; they'll enable the downsizing of today's 15-pound do-everything portables to 10 pounds within the next year.

Compaq currently holds the leader's role among purveyors of multiplatter 3.5-inch disk drives, thanks to the breathtaking Conner-built 19-millisecond 60MB and 120MB disks on the Compaq SLT 386s/20.

> According to NEC, half of all buyers of high-end portables opt for docking stations. The best are click-and-run affairs that provide configuration information.

All floppy disk drives now are 1.44MB 3.5-inch high-density units, which read and write 720K disks perfectly. You are not likely to see any more laptops with 2.5-inch floppy disk drives anytime soon, based on Zenith's misadventure last year with the MinisPort.

- **Expansion units.** According to NEC, half of all buyers of high-end portables opt for docking stations, also called expansion units or expansion stations. These cost $1,000 to $1,500.

The best expansion units are click-and-run affairs that provide configuration information, so your portable automatically knows about the hard disk, tape drive, 5.25-inch floppy disk drive, high-resolution video card, network adapter, and modem in the expansion unit. These are especially popular when a company settles on one brand of portable for all its business travelers and outside sales force. The traveling user brings a portable into the office, finds an open desk with a docking station, snaps the portable in place, and ties into the company's computing resources in less than 30 seconds.

- **Connectivity.** If you want to tie into a network, you can buy Ethernet, Token-Ring, and other adapters for most portables from the vendor or third parties. In some cases, the network card fits in the modem slot, so you can use either the network or a modem but not both. Alternatively, you can plug your network card into a docking station, use a parallel-port network adapter such as Xircom's, or piggyback onto a desktop PC's network connection with a zero-slot LAN such as Traveling Software's *DeskLink* or Artisoft's *LANtastic /Z*. (For details on that idea, see "Zero-Slot LANs," *PC Magazine*, April 24, 1990.)

Last year it appeared that some companies were going to build proprietary expansion slots common to their lines to encourage third-party developers. Now, they're backsliding. NEC, for instance, has omitted the ProSpeed 286 and ProSpeed SX LTX slot from its pending ProSpeed SX/20.

For more on connecting your portable with the outside world, see "Portable Productivity: Communications and Connectivity," *PC Magazine*, May 15, 1990. For information on fax modems useful with portables, see the sidebar "Fax Modems: The External Connection" in our August 1990 issue (page 350).

- **Batteries, power, and power conservation.** Regrettably, there is still no revolutionary new power source that will double or triple battery running time. Most progress comes in the form of lower power consumption.

Every portable dims the display and spins down the hard disk after a few minutes of inactivity. Several provide a deep-sleep or standby mode that lets you go away for lunch with minimal drain on the battery. Better still is instant resume (Toshiba calls it AutoResume), which saves your session to nonvolatile RAM, or sometimes to the hard disk. When you hit this button to turn your unit off, you can be up and running again in a second or two, rather than the minute or two required to perform a cold boot and reload your program and data files from disk.

Virtually all portables have quick-change batteries. If you want more time away from the power line, just buy extra batteries. Some batteries recharge in 2 to 3 hours; others still require an overnight charge. Several vendors sell external chargers that keep multiple spares topped up at all times.

In all cases, be sure to follow the manufacturer's instructions for prolonging battery life. With nickel cadmium

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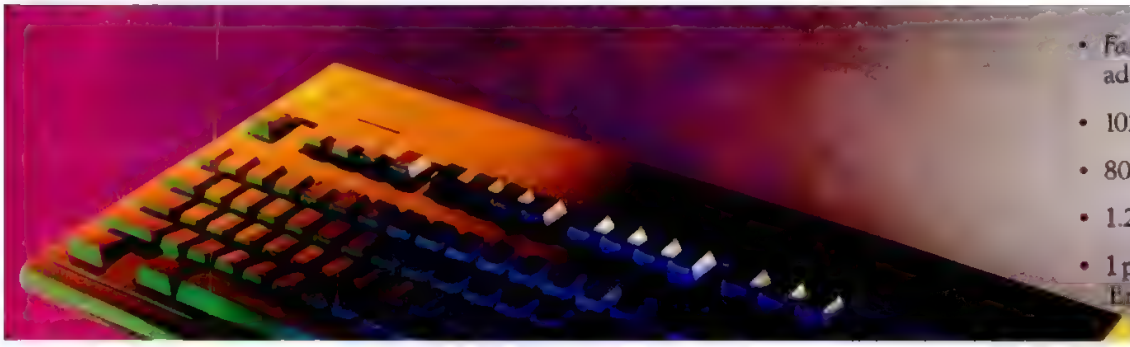

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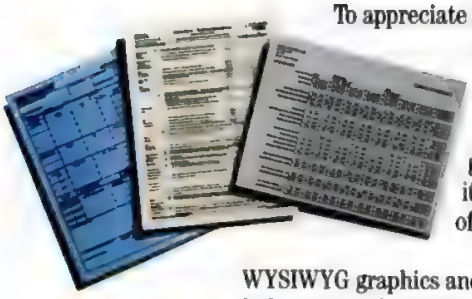

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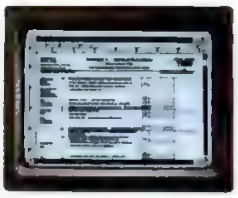

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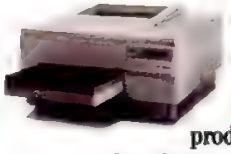

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batteries, that means letting them fully discharge before recharging; otherwise they develop "memory" and quit working before they should.

Buying tip: If you regularly carry your portable between two office sites, or between home and office, buy a second transformer and keep one in each location.

By the way, just about every portable today runs on both 110 and 220 volts, so you can take your machine anywhere in the world. A handful of portables offer 12-volt adapters to let you work in your car or boat.

■ **Keyboard.** Most machines have industry-standard .75-inch key spacing now, with 10 or 12 function keys across the top. Some have only four cursor keys, forcing you to hit Fn and an arrow key for PgUp, PgDn, Home, and End. None have separate numeric keypads (you can hit NumLock and temporarily use the right half of the alpha pad), but most offer plug-in numeric keypads ($100 to $150) for number crunchers. Some also provide connectors for external keyboards.

Of course, there are differences in keyboard feel among the machines, but choosing one is a subjective call.

■ **Caveat emptor.** When you compare prices, make sure you're looking at comparably equipped systems. Add $100 if DOS isn't included with the system. Occasionally, a battery-capable portable comes only with the AC transformer, or with only one one of two batteries. This may also affect the weight the manufacturer quotes.

Carry cases typically are extra. So are modems. External floppy disk drives for no-floppy-disk portables (such as the units from Sharp and Texas Instruments) will usually cost extra.

REVIEW CRITERIA

To be included in this review, a portable PC had to meet the criteria of what we believe are the two most significant DOS-to-travel categories: a battery-powered 386 CPU, with no weight restriction, or a battery-powered 286 unit weighing no more than 8.5 pounds. The computers had to be new machines (not reviewed in our special issue on portables, March 13, 1990) and had to be available to buyers at the beginning of this summer.

We expected the 386 units to be SX machines, but we didn't discriminate when Zenith opted for a standard 386 DX CPU. We also reevaluated two Editor's Choice portables: the Compaq LTE/286, which, with the 8086-based LTE, defined the notebook market, and the Toshiba T3100SX, which we consider the best SX portable.

Setting the weight ceiling for notebook PCs at 8 pounds was no arbitrary decision. We believe that a notebook starts to lose its go-anywhere appeal once it pushes beyond 6 pounds, but the market sees the heaviest of the 286 notebook units—the Compaqs and Toshibas—as the leaders. Note that Toshiba's T1200XE began life at 7.9 pounds, but with a newer, denser battery, it weighs a shade over 8 pounds.

We asked vendors to provide machines outfitted the way they would be used in business, with 2MB of memory, their best modems, carrying cases, and all the accessories, including docking stations.

The Sharp PC-6220 and Texas Instruments TravelMate 2000 are reviewed together because they are the same machine, designed by Sharp and built by Texas Instruments. The TI has a different case than the Sharp and includes a handful of extra utilities. We suspect the biggest difference is that TI will attract sales from people who want to Buy American. Don't laugh; it will happen. Also expect to see the same machine pop up under additional labels, for instance as the CompuAdd Companion (with a street price of $2,895).

JUST MISSED

More than a dozen battery-powered portables shipped too late for testing by PC Labs. They include: Airis (VH-286), Altima (NSX), American Mitac (LT 386SX), CompuAdd (316SL and Companion), Commax (Excell LT-386SX), Dataworld, GoldStar, Hyundai, Leading Edge, NEC (ProSpeed SX/20, UltraLite 286V), Tandon (LT-SX), and Top PCs (LT5600). In addition, NEC was unable to provide for review its 16-MHz ProSpeed SX, which was announced in March.

The Airis VH-286 has the most exciting specs: the price is $1,895 for a 6-pound, 12-MHz 286 with 2MB RAM, a 20MB hard disk (but no internal floppy disk drive), a backlit 11-inch VGA display, and a 2,400-bps modem. You can use either line current or a rechargeable battery, or you can drop in ten standard C-cell batteries for a claimed 12-hour battery life. Engineered in Chicago by a group of Zenith veterans, the Airis is planned strictly as a mail-order machine. It was to have shipped in spring, but financing problems (not uncommon to start-ups) pushed the schedule back to late summer or early fall.

NEC's ProSpeed SX/20 has a 20-MHz 386SX processor, 1MB RAM (5MB maximum), 40MB hard disk, 1.44MB floppy disk drive, VGA display, removable keyboard, "intelligent reconfiguration" when connected to an NEC docking station, and a tentative $5,999 list price. Its weight including battery is 12.6 pounds.

NEC also just missed our deadline with its UltraLite 286V, which looks like the fatter big brother of the familiar NEC UltraLite. In fact, that's what it is: 1.7 by 12 by 9 inches and 6.5 pounds (versus the UltraLite's 1.4 by 11.75 by 8.25 inches and 4.1 pounds). The 286V includes 1MB RAM (expandable to 2MB or 5MB), a 20MB hard disk, and a VGA display. The $3,999 price will include an external 1.44MB floppy disk drive, but the 2,400-bps modem—standard on the UltraLite—will now be optional.

NEC retains the ROM card slot in the 286V, an odd decision because only a few applications were ever published, and most of those are woefully out of date. In addition, NEC acknowledges that it is likely to shift to a new, incompatible ROM card on future products, as agreed during an industry conclave in Japan this May. Yet NEC will continue to market the original UltraLite, reducing its price from $2,999 to $1,999 for a 2MB unit.

BUYING CONSIDERATIONS

What's the best portable for you? If this unit is going to be your only PC, you need lots of CPU power and a sizable hard disk. Look to one of the SX-powered portables reviewed here. Also check the machines previously reviewed in our issue of March

OUR CONTRIBUTORS

Bill Howard is executive editor of *PC Magazine*.

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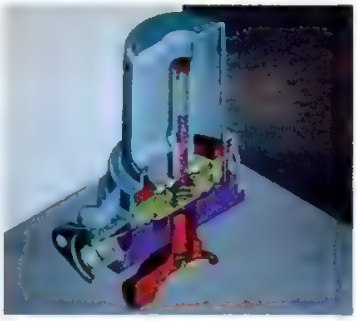

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6000™ family.
will seem downright primitive.

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13, 1990, particularly two of our Editor's Choices, the battery-powered Toshiba T3100SX and Dell 316LT.

If you don't need battery power, you'll find additional choices among AC-only portables, including 20- to 25-MHz 386 power, internal slots, and sometimes a separate numeric keypad. Best of the bunch: the IBM PS/2 Model 70 386 (20 MHz), Toshiba T5200/100 (20 MHz), and Dolch P.A.C. 386-25C (25 MHz), all Editor's Choices in March. Also check out the new Zeos 386SX Portable: $2,195 (street price) for a 12-pound, 4- by 14- by 15-inch AC-only machine with 1MB RAM and a 42MB hard disk.

If you have your heart set on a full-size 286 portable, keep your eyes open for ongoing price reductions and rebates. Rather than reducing the list price of a machine that will be discontinued in six months, the vendor often slaps on a $200 to $500 rebate.

If you want low-power, semiportable computing for next to nothing, you can expect even greater closeout deals on 12- to 15-pound 8088/8086 portables. With a 20MB hard disk, the price should be around $1,000. Just don't plan to do much beyond light word processing or electronic mail.

Our favorite light-duty notetakers are the Toshiba T1000SE and T1000XE, 8086-based 6-pounders with a single hard disk and floppy disk drive, for $1,699 and $2,699, respectively. With its recent $500 price reduction, the Compaq LTE begins to look a bit more reasonable ($2,999 with a 20MB hard disk and a 1.44MB floppy disk drive). Now that the NEC UltraLite is only $1,999 list, it's a great deal if you can live without a floppy disk drive. Just remember to recharge it weekly whether you use it or not.

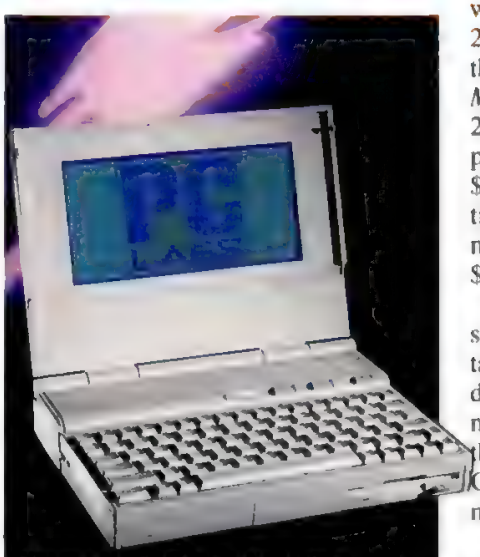
286-BASED PCS:

COMPAQ COMPUTER CORP.

Compaq LTE/286

by Fredric Burke

When you're looking at the latest in DOS for the road, Compaq's LTE/286 remains the class act in its field. Although the market has become crowded since the LTE/286 was introduced last year, this



Compaq leads the way in laptop technology with its Compaq LTE/286, priced at $5,418 in our standard configuration.

12-MHz 80286-based notebook-style computer leaves you wondering what other companies were thinking of when they designed their offerings. The Compaq LTE/286 has a nearly ideal combination of storage options, screen legibility, and portability.

One of the LTE/286's greatest appeals is the flexibility of its mass storage options. In its basic configuration, the Compaq LTE/286 comes standard with 640K of RAM, a 1.44MB internal floppy disk drive, and a parallel and a serial port. There are two models, each with a 29-millisecond Conner hard disk—20MB in the Model 20 ($3,999) and 40MB in the Model 40 ($4,799). RAM can be upgraded with a 1MB expansion board ($699) or a 2MB board ($1,299) and takes up one of the two proprietary slots. Thus, for *PC Magazine*'s standard configuration, with 2.6MB of RAM and DOS 3.31, you could purchase the Model 20 at a list price of $5,418. Our tested unit added two options, an internal modem and an 80287 math coprocessor, for a total price of $6,666.

Other options are Compaq's external storage module ($349), either a 60MB tape drive ($799) or a 5.25-inch floppy disk drive ($275), and an external numeric keypad ($119). These are housed in the two proprietary external ports. The Compaq will also support an external CGA monitor.

These storage options would be wasted if the screen were illegible. Again Compaq excels by setting standards for its screen that others would do well to emulate. While the electroluminescent backlit supertwist LCD offers only single-scan 640 by 200 CGA resolution, the screen is eminently readable. What Compaq does with four scales of gray will dazzle you. You can read characters and graphics very easily, adjusting for brightness and contrast with a surpisingly large array of controls, which allow the screen to show its best in many lighting conditions.

Compaq also realizes that a portable is less so if the battery isn't up to snuff. The LTE/286's 1.5-pound nickel cadmium battery pack ran away with the battery rundown tests, posting a time of 3 hours 37 minutes. The battery's life can be extended through a variety of power-saving utilities. After a user-ordained period of inactivity, the machine will shut down the hard disk and other components in order; two beeps and the system itself will shut down into standby status, saving any open files and active programs until brought to life when the standby button is pressed. Compaq also sells extra battery packs ($129) and an external fast charger ($199) to replace the standard one that comes with the unit.

Many laptop keyboards are exercises in compromise, and unfortunately the LTE/286 does little to advance the art of keyboard design. The keys on the Compaq's flat 80-key keyboard are normally spaced and well sculpted, with decent feedback. The placement of the four cursor keys, however, makes their use clumsy at best; the Up and Down Arrows are stacked to the right of the Left and Right

FACT FILE

Compaq LTE/286
Compaq Computer Corp., 20555 State Hwy. 249, Houston, TX 77070; (800) 231-0900, (713) 370-0670.
List Price: Model 20, with 640K RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, CGA electroluminescent backlit liquid crystal display, one parallel and one serial port, utilities, $3,999; with 2.6MB RAM, DOS 3.31, $5,418; with 2,400-bps internal modem, 80287 coprocessor, $6,666. Upgrade to 40MB hard disk (Model 40), $800.
In Short: Compaq once again leads the way in laptop notebooks, with the most powerful and versatile 286 machine available on the market. Its small size and long-life battery make it ideal for taking DOS on the road.

CIRCLE 427 ON READER SERVICE CARD

In Redondo Beach, California . . .

You'll find breathtaking ocean views, sensational surfers and Gateway 2000 computers.

Dive 'N Surf, famous for Body Glove® fashions and watersports equipment, is a member of the growing family of Gateway 2000 customers in California. Dive 'N Surf Computer Systems Manager Graham Pask chose a Gateway 25 MHZ 386 machine for his network server. The system runs point-of-sale, inventory control, word processing and desktop publishing software.

Graham Pask, Computer Systems Manager for Dive 'N Surf, and his Gateway 2000 25 MHZ 386 network server.

"I decided to buy a Gateway 2000 system because they had everything I wanted for a good price," said Graham. "But what really impressed me was the service. I had a problem with my 3 1/2 inch drive so they sent me a new drive the very next day."

Graham said he was so happy with his Gateway system at work that he bought a Gateway 2000 25 MHZ 386 Cache machine for his home.

Until well after sunset, surfers ride the big waves on the Pacific Ocean near Redondo Beach, California

And In Barrow, Alaska . . .

Over 300 miles north of the Arctic Circle, you'll find polar bears, seals, whales, walrus, lemmings, snowy owls and what appear to be the largest mosquitoes in existence. On a summer afternoon you'll also see parka-clad tourists walking among local residents in shorts. And of course you'll find a good Mexican restaurant and Gateway 2000 computers.

Jeff Frier, Cape Smythe Air Service, with his Gateway 2000 386SX.

Cape Smythe Air Service, a regional commuter airline serving Barrow, Kotzebue, Nome and remote villages in Alaska, has one of several Gateway 2000 computers operating in Barrow. Jeff Frier, Cape Smythe's accountant, chose a Gateway 2000 386SX to run spreadsheet, data base and accounting applications.

"I was trying to decide between Gateway 2000 and a competitor," Jeff commented, "so I talked to a person who owns the competitor's system. He was disgruntled about the service he received from them. Then I talked to another person in Barrow who has a Gateway and she was happy with the product and service. The choice was pretty obvious -- when you're doing business in a remote area, the most important things a vendor can offer are reliability and good service."

Jeff said he also appreciated Gateway's features and price. "When you have to pay $6 a gallon for milk, it's nice to find a bargain somewhere." Jeff plans to buy another Gateway 2000 computer in a few months .

On a mid-July day in Barrow, Alaska, fishing boats weave in and out of icebergs on the Chukchi Sea.

Near Camp Verde, Texas . . .

You'll find the magnificent Hill Country of Texas with rattlesnakes, prickly pear cactus and huge cattle ranches. You'll also find Larry Mahan and his Gateway 2000 computer.

Larry Mahan is to rodeo what Jack Nicklaus is to golf. He is Six Times World Champion All-Around Cowboy and is a member of the Cowboy Hall of Fame. But Larry also runs a cattle and horse ranch and is involved in a western apparel manufacturing company and a new Southwestern foods company. His Gateway 2000 20 MHZ 386 system is an integral part of his business operations. "We run cow and calf software for our Longhorn cattle herd," Larry said. "You can't really manage a livestock business efficiently without it. Plus we do accounting, spreadsheets and word processing on our Gateway 2000 computer."

Larry Mahan, rodeo star, and his Gateway 2000 20 MHZ 386 system.

Asked why he chose Gateway 2000, Larry said, "They had the best features and price – and I thought a computer company that puts pictures of cattle in their ads had to be my kind of people. And I was right. The people I've talked with at Gateway 2000 are honest-to-goodness nice folks. It's a pleasure doing business with them."

Larry Mahan raises registered Texas Longhorn cattle

TRACY'S
SHOES
Al & Al Pastries

In Bradford, Pennsylvania . . .

You'll find a charming small city nestled in the Allegheny National Forest. The city's most prominent local business is the Zippo Manufacturing Company, where you'll find 18 Gateway 2000 computers in use.

Fred Gronemeyer, Zippo Manufacturing Company, and his Gateway 2000 20 MHZ 386 system.

Zippo is known around the world for its windproof lighter made famous during the second World War, although today the company's product line includes many other specialty advertising items. Fred Gronemeyer, Systems Analyst for Zippo, chose Gateway 2000 as the company's standard PC.

"We needed to set standards for PC's and software to make the most efficient use of these tools," Fred remarked. "We started out with PC's from different manufacturers, but once I tried Gateway I was convinced we could get the highest quality, most reliable machines at the best price from Gateway 2000. I was also impressed by my salesman and the tech support people I've dealt with at Gateway."

Fred said by the end of the year Zippo will be running every system Gateway 2000 makes, from 286's up to a 486 and everything in between.

Main Street, U.S.A., is located in Bradford, Pennsylvania.

ADE
Hertz
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And In New York City . . .

You'll find your senses overwhelmed by the countless sights and sounds of this one-of-a-kind city. And of course you'll find thousands of Gateway 2000 computers here.

One New York City Gateway 2000 owner is

Jim Rondinelli, independent record producer and engineer, with his Gateway 2000 386SX.

independent record producer and engineer Jim Rondinelli. Jim uses his Gateway 2000 386SX with a sophisticated player piano sequencer to compose music.

"The software I use is written for the Mac and for IBM compatibles," Jim said, "but it runs much better on IBM compatibles. And it runs best of all on my Gateway. I travel often and I've used my software on a lot of other machines. They don't even compare with my Gateway 2000."

Jim said he bought his Gateway 2000 because it was equipped for the real world with ample hard drive capacity and RAM, both sizes of disk drives and color VGA graphics.

"It's the fastest file transfer computer I've ever used," continued Jim, "plus it ran right out of the box. One afternoon and I was fully functional on a brand new system."

The streets of Manhattan are a constant blur of activity.

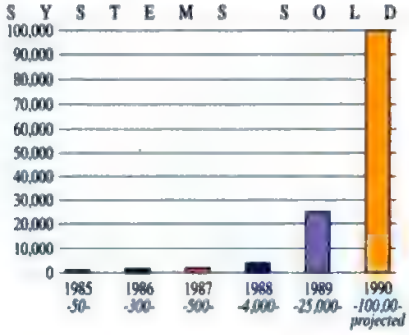
ACROSS THE COUNTRY YOU'LL FIND

You'll find so many Gateway 2000 computers in so many places today because people everywhere know a good value when they see one. In all 50 states and in over 70 foreign countries, thousands of people are comparing prices, quality and service – and choosing Gateway 2000.

But value alone doesn't explain how a little company in the Midwest, started just five years ago, managed to outdistance hundreds of other companies, selling more systems through the direct market channel today than any other PC manufacturer in the country.

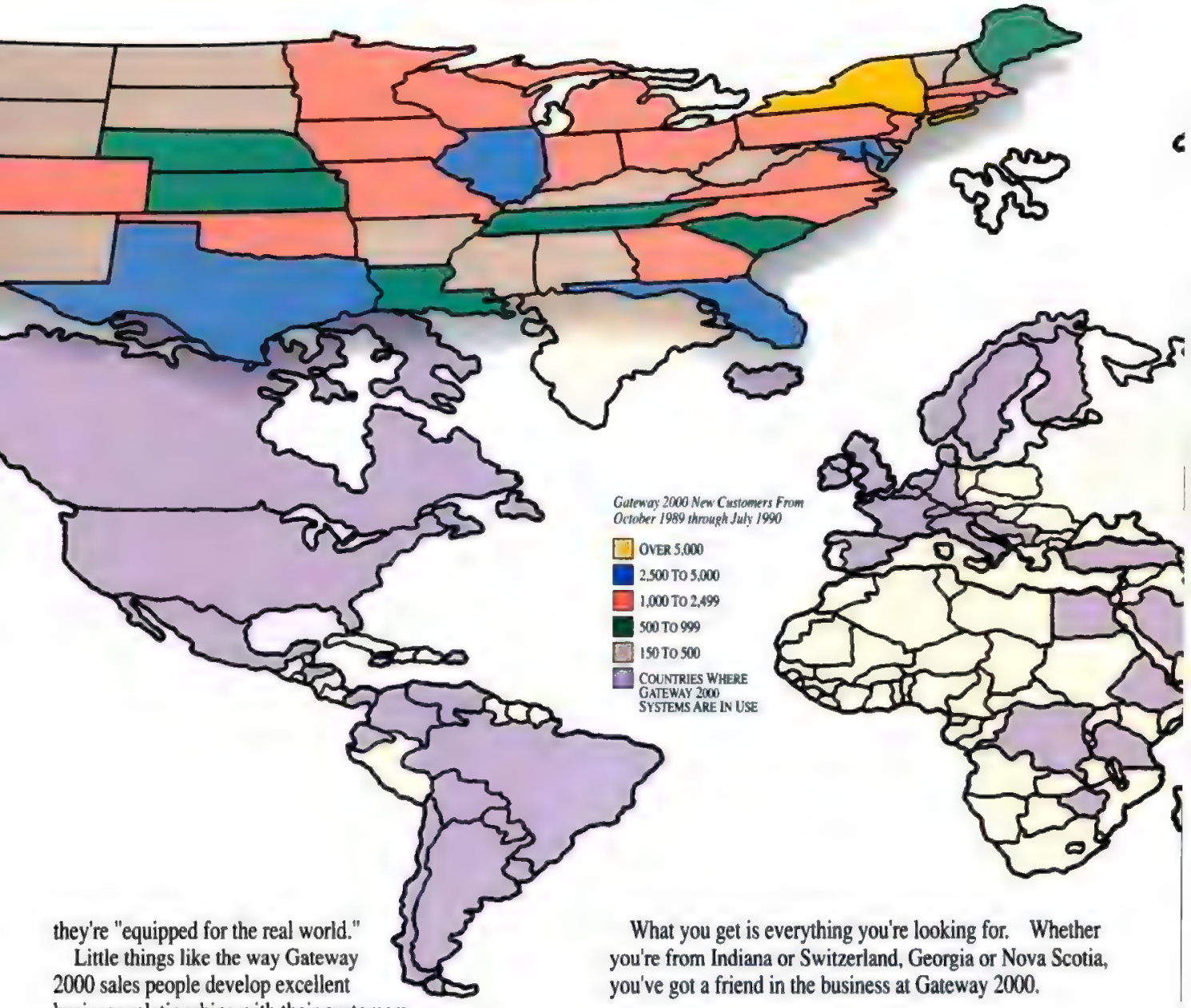
The explanation is that the company has always maintained a small company attitude. With Gateway 2000, you still get the little things you'd expect only from a small firm.

Little things like a positive technical support department. When Graham Pask told his Gateway 2000 tech rep that his 3 1/2" drive didn't work, he received a new drive the very next day.



Little things like the way Gateway 2000 systems are fully loaded with all the features you want. Jim Rondinelli bought a Gateway 2000 computer because

AND AROUND THE WORLD, GATEWAY 2000!



they're "equipped for the real world."

Little things like the way Gateway 2000 sales people develop excellent business relationships with their customers. Fred Gronemeyer tried his first Gateway because he was impressed by his sales person. Eighteen systems later, Fred is still impressed by his sales person.

And the biggest little thing of all is the feeling you get when you deal with the people at Gateway 2000. As Larry Mahan said, "they're honest-to-goodness nice folks."

Compare prices, quality and service. Then add up the little things you get from small town people running an old-fashioned, high-tech business.

What you get is everything you're looking for. Whether you're from Indiana or Switzerland, Georgia or Nova Scotia, you've got a friend in the business at Gateway 2000.

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- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
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- 1.2 Meg 5.25" Drive
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- 40 Meg 17ms IDE Drive
- 16 Bit VGA with 512K
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- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
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- 101 Key Keyboard
- MS DOS 3.3 or 4.01
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- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01
- MS WINDOWS 3.0

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25MHZ 486VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5.25" Drive
- 1.44 Meg 3.5" Drive
- 150 Meg ESDI Drive
- ESDI Cache Controller
- 16 Bit VGA with 512K
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If our standard configurations don't fit your needs, we'll be happy to custom configure a system just for you. Due to the volatility of the DRAM market, all prices are subject to change.

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Arrow keys. The keyboard relegates PgUp, PgDn, Home, and End to alternate-key status. This is a reasonable compromise given the tiny dimensions of the machine (1.5 by 8.5 by 11.0 inches), but it does interfere with easily adapting to the machine.

For something as small as the LTE/286, its weight is surprising at first. Packing enough equipment to make it a mobile office, our tested LTE/286 tips the scales at 7.25 pounds, including a 1.5-pound battery. Given Compaq's legendary durability and the all-of-a-piece feel, you may suddenly discover you don't mind having that weight swinging at the end of your arm or in its optional nylon carrying case.

Making full use of the Compaq LTE/286's abilities can be an expensive proposition—a common complaint with Compaq machines. A fully equipped LTE/286 can cost upwards of $8,000, and the

A NEW TWIST FOR LAPTOPS

Improvements in LCD technology may not have progressed far enough to let you retire your desktop color VGA monitor, but that day is coming. . . .

by Alfred Poor

Ever since RCA's early experiments in LCD technology in the late 1960s, liquid crystal displays have been the favorite for electronic designs. First in calculators, and now in portable computers, these displays are in demand due to their small dimensions, light weight, and low power requirements.

Computer users are never satisfied, however. We want more power, more speed, and greater resolution in smaller, lighter packages that run forever on a single battery charge. Fortunately for our insatiable appetites, LCD technology is improving rapidly. In order to understand the improvements, we need to understand LCD technology in general. LCDs rely on strange compounds that act like solid oblong crystals, yet something like liquids.

Liquid crystals would simply be chemical oddities if not for two distinct traits. A layer of liquid crystals can actually twist light waves. Each pixel on a display requires a separate LCD cell; in each cell, a layer of liquid crystal material is sandwiched between two grooved surfaces. The crystals tend to line up with the grooves in these surfaces, and if these grooves are at right angles to each other, the crystals will shift their orientation depending on which surface they are nearer. Light waves will follow these changes in orientation and exit the layer twisted 90 degrees. The second trait is that you can get all the crystals to line up vertically, standing on end, simply by passing an electric current between the two surfaces. This allows light to pass through the layer unimpeded.

These two remarkable attributes make LCD panels possible. A polarizing filter on one side of the layer filters out all light waves except those that are oriented in the desired direction. The liquid crystal layer twists these waves so that when the light comes out the other side, it is oriented to pass through another polarizing filter arranged at right angles to the first one, so the pixel appears bright. When transparent electrodes apply a charge to the two sides of the layer, the crystals line up so the light passes through unchanged; the light is then blocked by the second polarizing filter since the waves are not in the correct orientation. Thus the pixel is left dark, and the pattern of dark and light pixels forms the image.

MODERN ADVANTAGES

Compared with early LCD panels, today's products enjoy some distinct improvements. They are thinner, and there is greater contrast between "on" and "off" pixels. Active matrix panels are one new development that has made these improvements possible. Also known as TFT (for *thin film transistor*) technology, this approach places a transistor in each pixel; it permits more-precise control of the voltages applied to turn a cell on or off. This also permits halftone displays ("partially on" pixels), higher contrast, and faster response.

Another advance relates to how the light is twisted in an LCD panel. The original designs always put the light waves through a 90-degree twist; this is called *twisted nematic* (TN) technology. *Supertwist nematic* (STN) designs twisted the light waves 180 to 260 degrees; this improved the contrast but also gave rise to the familiar yellow-green or bright blue displays that we associate with laptop screens.

Two liquid crystals twisting light in opposite directions eliminate the colored effect of STN designs; these *double supertwisted nematic* (DSTN) designs are the source of some of the black-and-white LCD screens in use today. Most recently, the compensating twists have been achieved through the use of plastic films on both sides of a supertwist layer; this technology is called a *triple supertwisted nematic* (TSTN) design. This last breakthrough is responsible for making multicolor displays practical.

A few portable computers already take advantage of these new technologies. Sharp and Texas Instruments have triple-twist monochrome screens on their newest notebooks. Dolch has a thin film transistor full-color screen for its high-end 386 and 486 portables, and other TFT designs are expected later this year from Airis and Sharp, among others.

Problems still remain in LCD technology. In order to reach resolutions of 800 by 600 for color portable screens, manufacturers must create panels that incorporate about 1.5 million perfect pixels. Since the newer LCD technology absorbs more and more light, we need brighter backlights that draw less power. So while you can get some impressive portable displays today, you will have to wait a bit longer before you can retire the heavy vacuum-tube monitor that sits on your desktop machine. ■

price was even higher before the machine was widely introduced. This does not detract from the computer's basic excellence. Its strengths are models for the rest of the 286 marketplace, particularly as there are few things the Compaq can't do.

Compaq's hardest job will be surpassing this machine, because the rest of the industry hasn't succeeded. Its expansion possibilities, ruggedness, and reliability, plus the security of the Compaq name, make the Compaq LTE/286 the standard of notebook-style laptops.

SHARP ELECTRONICS CORP.

Sharp PC-6220

TEXAS INSTRUMENTS INC.

TravelMate 2000

by Wendy Dugas-Pérez

Sleek. That's the first word that comes to mind when looking at Sharp's PC-6220 and Texas Instruments' TravelMate 2000. Designed and produced in a joint venture by Sharp and Texas Instruments, this 1.4- by 11- by 8.5-inch notebook weighs only 4.4 pounds. But for this light weight you definitely get heavyweight power. The basic configuration consists of 1MB RAM, a 20MB 23-millisecond hard disk, DOS 4.01, and *LapLink* 2.04 in ROM, VGA with backlighting, an internal nickel cadmium replaceable 2-hour battery, a power adapter, *LapLink* cables, and a manual. As far as prices go, for our standard configuration, which adds an extra megabyte of RAM and an external floppy disk drive to this basic configuration, the Sharp is priced at $4,793, while Texas Instruments comes in a little higher at $4,847. Even though you might wince at these price tags, think of what you'll be getting—a 12-MHz 286 system that you can carry in your briefcase!

With the Sharp PC-6220, $4,793 buys you a well-equipped 286 machine that weighs 4.4 pounds and has an innovative display.

FACT FILE
EDITOR'S CHOICE

Sharp PC-6220
Sharp Electronics Corp., Advanced Products Division, Sharp Plaza, Mahwah, NJ 07430-2135; (201) 529-8200.
List Price: With 1MB RAM, 20MB hard disk, triple supertwist VGA liquid crystal display, one parallel and one serial port, AC adapter, DOS 4.01, *LapLink* 2.04, $3,995; with 2MB RAM, external 1.44MB 3.5-inch floppy disk drive, $4,793.
In Short: While this portable weighs in at only 4.4 pounds, you still get a well-equipped 286 system. One notable feature of this notebook is a triple supertwist LCD VGA screen with 16 shades of gray, which will make it hard for you to go back to any other laptop screen. This is a great machine for commuting back and forth to the office or across the country.

CIRCLE **428** ON READER SERVICE CARD

In addition to what's included standard, many options are also available. If you just can't live without that floppy disk drive, you can attach a $299 external one to the back of the unit. A separate port is available if you prefer to attach an external keyboard. There is also an expansion bus to which you can connect an adapter (Sharp, $699; Texas Instruments, $799) enabling installation of two standard PC AT cards. If you work consistently with numbers, you can attach a numeric keypad ($99) to the side of the unit. For transcontinental flyers, when a 2-hour battery just won't do, an add-on battery ($249) will give you a total of 5 hours of battery time. A few other options worth mentioning are the Fax/Data modem priced at $499 and an 80287 math coprocessor for $799.

Although you can attach a separate monitor using the optional internal VGA CRT adapter ($149), unless you need color, don't bother. One of the most impressive features of these two laptops is their screens. Anyone who has longed to give presentations on a laptop without having to drag around a monitor will delight in this system. With its high-contrast triple supertwist 640 by 480 paper-white LCD VGA display with backlighting and 16 shades of gray, this screen will make your presentations look as impressive as you want them to.

When it comes to complaints regarding these machines, there are very few. The add-on battery, which screws onto the back of the unit, is awkward to attach. If it snapped into place it would be easier to use when you're trying to balance the machine on your lap. The fact that the covers for the ports are not attached is also a problem. You have to bend the covers slightly in the middle to get them off and then bend them again to put them back on. If the threat of snapping the covers in half when doing this isn't bad enough, trying to find them when you're ready to put them back on is. And speaking of misplacing parts, the conversion adapter supplied with the unit to enable you to use the special parallel port is a nuisance to carry around. Be sure to get the $99 carrying case or the adapter will probably end up wherever those port covers went.

All in all, these are impressive machines, and while the Sharp gets a slight edge for the look and feel of its rubberized case, this is balanced out by the fact that the Texas Instruments machine is made in the United States, not Japan. Both offer a one-year parts-and-labor warranty as well as one-way shipping charges when you

Texas Instruments' TravelMate 2000, priced at $4,847, packs a completely functional system into a diminutive case.

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CIRCLE 245 ON READER SERVICE CARD

About the only thin to make the perfe

Introducing ProLine.™ Don't judge a backup by its cover. Ours may not be painted Novell® red, but they're as close to perfection as you can get for Novell networks.

The ProLine series is the only server-based backup solution expressly designed for Novell 286 and 386™ networks. With backup technologies including ¼" cartridge, 4mm DAT, 8mm helical-scan tape and erasable optical, ProLine offers capacities from 250 MB to 2.2 GB for virtually any size network. But capacity is only the beginning.

The server-based approach means speed. With ProLine's server-based approach, the backup system attaches directly to the server. This means no server data moving across the network in order to be backed up. And this, in turn, means maximized backup speeds and network efficiency.

The key is Tecmar's ProServe™ software. Through ProServe's Value Added Process architecture (for NetWare® 286) and NetWare Loadable Module architecture (for NetWare 386), the software runs concurrently with the file server. And the VAP™ or NLM™ is integrated into the network operating system.

The result is unprecedented performance—up to 14.4 MB per minute.

ProLine doesn't stop with speed. With ProLine, you also get a lot more than speed. You get a complete network backup solution.

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ProLine even has a familiar C-worthy interface.

And unlike workstation-based architectures, ProLine's server-based approach means you don't have to dedicate an expensive workstation just for backup.

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g we haven't done ct Novell backup.

How to attain perfection.

Nobody else offers anything approaching the features of ProLine.

In addition to everything above (plus the dozen or so features we didn't have room to talk about), ProLine carries up to a two-year warranty. And our QuickTurn™ Quality Service program guarantees factory warranty service in 48 hours within the first six months of ownership.

So if you're interested in attaining perfection, there's only one thing to do. Call 1-800-624-8560. And we'll back up everything we've said.

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CIRCLE 384 ON READER SERVICE CARD

PORTABLE PCs: SUMMARY OF FEATURES

In this features table, the four 12-MHz 80C286-based notebook-style portables are listed first, in ascending price order based on the standard configurations. These are followed by the eight 16-MHz 80386SX portables, one 20-MHz 80386SX, and one 20-MHz 80386, all of them grouped together in increasing price order.

Price of standard configuration To allow comparisons, we are citing prices for similarly equipped machines. Our standard configuration here includes 2MB RAM, a 40MB hard disk (20MB for notebooks), one 1.44MB floppy disk drive, a display, one parallel and one serial port, and DOS 3.3 or 4.01. (To make the Sharp PC-6220 and TravelMate 2000 comparable, we are including an optional external floppy disk drive in the standard configuration for each of these units.) Variations in the RAM or hard disk capacity are shown in parentheses. See each machine's fact file for a more exact indication of what is included at the quoted price.

Distributed through dealers or direct Some machines are sold directly through mail order. When machines are sold by dealers, the purchaser may find discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high).

Case type All portables reviewed here have clamshell laptop designs, with rear-hinged displays, rather than lunchbox designs. "Notebook" indicates a unit weighing 8.5 pounds or less, while a "sandwich" unit has a removable keyboard sandwiched between the case and display.

Display system and **maximum resolution** indicate the best video standard supported (VGA, EGA, CGA, or double-scan CGA) and the highest available resolution (in pixels, width by height).

Display technology indicates the type of display (liquid crystal, gas plasma, or electroluminescent) and the type of illumination. All portables reviewed here have illuminated displays.

Chip set manufacturer indicates which company makes the logic that connects the CPU with the other functions supported by the system board. Chip sets that employ VLSI (very large scale integration) technology reduce the discrete component count, which helps to reduce power consumption and increase component life.

The **system RAM arrangement** refers to the method by which memory is addressed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, avoiding wait states.

Row/column is the traditional method of accessing data at a memory address. RAM is mapped as a matrix, and a particular address is given using a row and a column number.

Wait states On the average, most machines run at between zero and one wait state. The figures printed here were supplied by the manufacturers.

RAM (minimum/maximum) indicates the amount of memory that can be installed in the unit; this is followed by the amount of **installed RAM** on the machine that PC Labs tested.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, ZIPs, and SIMMs.

The *dual in-line package (DIP)* is the traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection. Similar to SIPs are *ZIPs (zig-zag in-line packages)*, in which every other pin connection is slightly offset, creating a zig-zag pattern.

Single in-line memory modules (SIMMs) are individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively. Combination chips (4x256Kb) are generally faster and more expensive.

A **processor RAM cache** acts as a bridge between the CPU and the slower main memory. The cache comprises a small bundle (typically 32K to 128K) of fast SRAM chips. The cache controller is designed to predict and retrieve the data the CPU is likely to require next, thus preventing wait states. There are two varieties of controllers: discrete logic chips (designed by the individual manufacturers) and VLSI chips like the Intel 82385.

The **BIOS version and date** can affect PC Labs' benchmark test results. A machine with a different BIOS may reveal performance variations.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS from slower ROM into faster RAM on boot-up. Shadowing uses RAM located between 640K and 1MB.

Hard disk capacity and size shows the capacity (in megabytes) and the platter size of the hard disk in the tested configuration. 2.5-inch hard disks provide substantial weight and size savings over 3.5-inch disks but are currently limited to 20MB.

Interface Within the PC environment, the three most common hard disk interfaces are *ST-506, SCSI (small computer system interface)*, and *ESDI (enhanced small device interface)*. ST-506 uses one of two data encoding methods, *RLL (run length limited)* or the older *MFM (modified frequency modulation)* scheme. Both SCSI and ESDI require special hard disk controllers. *IDE (interface design enhancements)* is a relatively

	Sharp Electronics Corp. **Sharp PC-6220**	Texas Instruments Inc. **TravelMate 2000**	Toshiba America Information Systems Inc. **Toshiba T1200XE**	Compaq Computer Corp. **Compaq LTE/286**	Arima Computer Corp. **Arima ACT 386SX-420**	Impulse Systems Inc. **Impulse SX**
Price of standard configuration	$4,793	$4,847	$5,098 (3MB RAM)	$5,418 (2.6MB RAM)	$2,995	$3,395
Distributed through dealers or direct	Dealers	Dealers	Dealers	Dealers	Dealers	Dealers
TESTED CONFIGURATION						
Microprocessor	12-MHz 80C286	12-MHz 80C286	12-MHz 80C286	12-MHz 80C286	16-MHz 80386SX	16-MHz 80386SX
Power supply	Battery, AC	Battery, AC	Battery, AC	Battery	Battery, AC	Battery
Case type	Clamshell (notebook)	Clamshell (notebook)	Clamshell (notebook)	Clamshell (notebook)	Clamshell (sandwich)	Clamshell
Dimensions (HWD, in inches)	1.4 x 11 x 8.5*	1.4 x 11 x 8.5*	2 x 12.2 x 11	1.9 x 11 x 8.5	3.9 x 13.9 x 8.6	3.8 x 13.3 x 13.3
Weight (lbs.)	4.4*	4.4*	8.5	7.3	13.7	14.4
Display system	VGA	VGA	Double-scan CGA	CGA	VGA	VGA
Maximum resolution (pixels)	640 x 480	640 x 480	640 x 400	640 x 200	640 x 480	640 x 480
Display area (WxH, in inches)	8 x 6	8 x 6	7.8 x 4.9	7.7 x 3.7	7.9 x 4.5	7.8 x 5.8

—Editor's Choice ■—Yes □—No N/A—Not applicable: the product does not have this feature.
* Sharp PC-6220, TravelMate 2000: 2.5 x 11 x 12.5 inches, 6 lbs. with clip-on 1.44MB floppy disk drive ($299):1.4 x 11 x 10 inches, 5.5 lbs. with clip-on 3-hour battery ($249).

new interface that incorporates the controller onto the hard disk and uses RLL encoding.

Bus speeds Most PCs and portables run their system (expansion) buses at 8 MHz. Faster speeds may cause compatibility problems with peripherals.

ISA/MCA/EISA expansion slot indicates whether the portable can internally accept the standard accessory cards used in desktop PCs. *ISA*, Industry Standard Architecture, is the classic bus design of mainstream PC compatibles. *MCA* is Micro Channel architecture (developed for the IBM PS/2). *EISA* is Extended Industry Standard Architecture, an extension of ISA.

Proprietary expansion slots refers to machine-specific slots most commonly used by modems. Sometimes the slots can also be used for network adapters or fax modems.

An **external expansion port** means that the system bus can be connected to external devices such as an expansion station or external floppy disk drive. (A few older portables may use the parallel port as the expansion connector. This does not pass all signals of the system bus, but it is adequate for connecting floppy disk drives.)

An **expansion unit**, also called a docking station or expansion station, provides space for standard expansion cards and hard disks, tape drives, or floppy disk drives. Some portables automatically reconfigure to recognize the expansion unit and its contents (**self-configuration**). Some portables click the unit into place with a single step (**single connection**); others require you make multiple connections for power, signal, video, and modem.

Video modes supported indicates all common video modes: Super VGA, VGA, EGA, CGA, HGA (Hercules), and MDA (monochrome). Double-scan CGA is a superset of CGA and provides 640 by 400, 640 by 200, and 320 by 200 resolution; while this is better than a CGA-only display, VGA is preferable.

Number of gray scales indicates how many shades of gray the unit can display at the maximum resolution.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Supports internal and external displays simultaneously A yes answer means that an external monitor can be connected without blanking the portable's flat-panel display. This is useful for small-group demonstrations.

The keyboard section shows the total **number of keys,** the number of **function keys** (10 or 12), and the number of **cursor keys** (4 or 8). With four cursor keys, to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys, which is an inconvenience.

Software available The availability and price of DOS 3.3 and 4.01 are listed here. If no price is shown, the base-priced system includes DOS. (*PC Magazine*'s standard configuration includes DOS 4.01—or, if it is not available, DOS 3.3—to allow more-accurate price comparisons.) Where OS/2 is available, the version number and list price are provided.

Disk caching software buffers, or caches, the most recently read data from the hard disk, providing significant speed improvements. You need extra memory (beyond 1MB) for best results.

An **expanded memory manager** is a device driver used to emulate expanded memory in the extended memory of a 286, 386SX, or 386 PC. The most popular expanded memory managers follow the Lotus/Intel/Microsoft (LIM) specification.

Internal modem lists the speed and list price of the vendor's preferred modem. 2,400-bit-per-second and faster modems benefit from built-in error correction. *MNP 5 compression* is the most widespread form of data compression in use today and includes MNP 2 to MNP 4 error correction. *V.42 error correction* is an emerging standard, as is *V.42 bis compression*, which includes V.42 correction. Whenever possible, you should strongly consider MNP 5 compression as a minimum requirement.

If a machine has **dual voltage,** a switch on the power supply permits use with both 110- and 220-volt current.

Claimed battery life is the vendor's rating for the internal battery or batteries. PC Labs independently measures battery life and reports the results in the benchmark test section. **Battery charge time** is measured with the machine off; it may be longer with the machine in use. Where two times are listed, the second is for an optional heavy-duty battery or for a supplemental external battery.

Battery conservation techniques include automatically dimming or blanking the display and turning off the hard disk (common to most portables now), slowing or halting the CPU, and removing power from I/O ports (modem and serial ports) when the machine is not in use.

A **standby or auto-resume mode** means that the user can suspend operation, write the contents of memory to battery-backed RAM (or the hard disk), place the unit in low-drain sleep mode, and resume operation hours later without having to go through the time and effort of the boot-up process.

The **transformer weight** and **size** can vary significantly among machines with similar power needs.

FCC Class B certification means that an electronic device has sufficiently low radio-frequency (RF) emissions to be used in the home. The less stringent Class A certification restricts devices to the office. Portable PCs must have Class B certification.

Vendors sometimes describe a machine as "Class B pending," but the term carries no legal weight. A yes answer in this row means the unit has received Federal Communications Commission approval as of *PC Magazine*'s editorial deadline.

Twinhead Corp. **Twinhead Superlap SX** $4,095	Intelligence Technology Corp. **ITC 386 PEP** $4,244	Data General Corp. **Walkabout/SX** $5,395	Epson America Inc. **Epson Equity LT-386SX** $5,598	Compaq Computer Corp. **Compaq SLT 386s/20** $6,799 (60MB hard disk)	Toshiba America Information Systems Inc. **Toshiba T3100SX** $6,998 (3MB RAM)	Zenith Data GRiD Systems Corp. **GRiD 1450sx** $7,483 (3MB RAM)	Systems **Zenith TurbosPort 386e** $7,499
Dealers	Direct	Both	Dealers	Dealers	Dealers	Direct	Dealers
16 MHz 80386SX	16-MHz 80386SX	16 MHz 80386SX	16 MHz 80386SX	20 MHz 80386SX	16 MHz 80386SX	16-MHz 80386SX	20-MHz 80386
Battery, AC	Battery	Battery, AC	Battery, AC	Battery	Battery	Battery, AC	Battery, AC
Clamshell (sandwich)	Clamshell	Clamshell	Clamshell	Clamshell (sandwich)	Clamshell	Clamshell	Clamshell
3.5 x 12.8 x 9.5	2.5 x 11.8 x 12	3 3 x 12.8 x 14.8	3.7 x 12 7 x 11.7	4.1 x 8.5 x 13.5	3 3 x 12 5 x 14.3	2.6 x 11 5 x 12 5	4 8 x 13.3 x 14.8
12.2	8	15.8	13	13.8	14.6	11 with 2-hour battery	18.5
VGA	VGA	VGA	VGA	VGA	VGA	VGA	VGA
640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480	640 x 480
6.5 x 8.5	9.3 x 5.8	8.3 x 5.1	8.3 x 6.3	7.8 x 5.9	7.8 x 5.9	7.8 x 4.9	8.3 x 6.3

CONTINUES

Cure For The Common Clone

IMAGINE. 386sx power, 200 MB-HD, 8 MB RAM, 1024 x 768 VGA with an internal modem...and it fits in a briefcase!

Introducing the Brick.™ A 386sx with enough power, storage and graphics capability to run the most demanding applications. And it's the first desktop PC that's quiet enough, small enough and elegant enough not to be banished instantly to the floor. This remarkable computer measures 3"x 8"x 11" and weighs only 8.3 lbs.

More Practical Than A Portable

The Brick offers an alternative to the usual trade-offs associated with laptops. Simply keep a full sized monitor and keyboard at your home and office, and carry just the Brick in between. You save half the cost, half the weight, and all the hassle of coordinating files between multiple machines. *You can have **one** machine with all your files wherever you need it.*

A Powerful And Quiet Desktop

Bricks are available with a 16 or 20 MHz 386sx; a 387sx coprocessor; 1 to 8 MB RAM; and your choice of a 40 (25ms), 100 (25ms), or 200 MB (16ms) hard disk. Bricks also deliver superb VGA graphics with 1MB video RAM supporting 800 x 600 and 1024 x 768 resolution for CAD, DTP or Windows. As an added benefit, the Brick is very quiet. Its rugged aluminum case serves as a heat sink so the whisper fan rarely runs.

832k for DOS

The Brick provides another welcome bonus: an extra 192k of memory above the DOS 640k limit. This unique feature allows you to load resident programs, such as a network or TSRs, into a contiguous 192k block of

The Brick fits in half a briefcase, leaving room for everything else you have to carry.

CIRCLE 479 ON READER SERVICE CARD

The Brick
3" x 8" x 11"
Only 8.3 lbs.

high memory, and still leave the lower 640k free. The regular Brick shown above also accepts an internal ISA 16-bit half length card, while the "Stretch Brick," shown at right, accepts one full and one half length card.

Great Value

Complete Brick systems start at just $2,495. For your convenience, we also offer pre-installed software packages – including the DESQview™ or the new Windows® 3.0 environments – and top-rated applications. For example, the system (shown above) including all standard Brick features with optional color VGA monitor; 4 MB RAM; and a 100 MB hard disk pre-programmed with DESQview 386, Quattro®, Sprint®, askSam™, DOS™ and Tree86™ is only $3,995! With this package, we also include our exclusive interactive "Talking Tutorial" that quickly teaches you how to use each program. *Yes, the Brick actually talks.*

Optional paper white VGA LCD display with back-lit super twist technology.

Guaranteed Satisfaction

Because we are a direct selling manufacturer, we have a direct interest in the complete satisfaction of each and every customer. To ensure that satisfaction, **Ergo** offers: a 30-day money back guarantee, a One Year Warranty, unlimited 800-line support and our exclusive Advanced Diagnostics via modem.

Free Catalog

You'll find complete information on all Brick systems, plus a full complement of enhancements including FAX and networking cards, tape backup unit, cases, monitors and more in our 32-page catalog. Why not call for it today?

Ergo also offers a line of traditional 386 computers, from 16 to 33 MHz, starting at just $1,895. Call us at **1-800-633-1925** and we'll help you select the system that best meets *your* needs.

$2,495

System Includes

- Stretch Brick
- 16 MHz Intel 386sx
- 1 MB RAM, Exp. to 8 MB
- 40 MB hard disk with password protection
- Mono VGA monitor
- 16-bit full and 8-bit half card expansion slots

Standard Features

- 1024 x 768 VGA controller with 1MB video RAM and EGA, CGA, MDA support
- 101 keyboard
- 2,400 bps modem
- 3.5" 1.44 MB floppy
- 2 serial & 1 parallel port
- World wide AC power
- Hypertext manual
- 832k DOS capable
- LIM 4.0 EMS support
- One Year Warranty
- Freight included

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PORTABLE PCs: SUMMARY OF FEATURES

	Sharp Electronics Corp. **Sharp PC-6220**	Texas Instruments Inc. **TravelMate 2000**	Toshiba America Information Systems Inc. **Toshiba T1200XE**	Compaq Computer Corp. **Compaq LTE/286**	Arima Computer Corp. **Arima ACT 386SX-420**	Impulse Systems Inc. **Impulse SX**
TESTED CONFIGURATION						
Display technology	Triple supertwist LCD	Triple supertwist LCD	Sidelit supertwist LCD	Backlit EL supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD
Motherboard manufacturer	Sharp	Texas Instruments	Toshiba	Compaq	Arima	Commax
Chip set manufacturer	Chips and Technologies	Sharp	Toshiba	Compaq	Chips and Technologies	Chips and Technologies
System RAM arrangement	Row/column	Row/column	Row/column	Row/column	Interleaved page-mode	Interleaved page-mode
Wait states	0, 1	0, 1	0	Less than 1	0	0
Coprocessor supported	80287	80287	None	80287	80387SX	80387SX
MEMORY						
RAM (minimum/maximum)	1MB–3MB	1MB–3MB	1MB–5MB	640K–2.6MB	1MB–4MB	1MB–5MB
Installed RAM	1MB	1MB	3MB	2.6MB	2MB	3MB
RAM packaging (and rated speed)	Proprietary (80 ns.)	Proprietary (80 ns.)	DRAM (80 ns., 70 ns.)	DIP (100 ns.)	SIMM (80 ns.)	DIP (100 ns.), SIMM (100 ns.)
Chip size	8x128Kb	8x128Kb	4x256Kb	64Kb, 256Kb	4x256Kb	1Mb/256K and 1Mb
Processor RAM cache	None	None	None	None	None	None
BIOS						
BIOS version and date	Phoenix 1.0B (5/90)	Phoenix 1.0B (5/90)	Award/Toshiba 1.0 (12/89)	Compaq (10/89)	AMI (12/89)	Quadtel 3.04.01-9 (1990)
Setup in ROM/Password in ROM	■/■	■/■	■/❑	❑/■	■/❑	■/❑
Video shadowing/System shadowing	❑/❑	❑/❑	■/■	❑/❑	❑/■	■/■
HARD DISK						
Capacity and size	20MB 2.5-inch	20MB 2.5-inch	20MB 2.5-inch	20MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch
Manufacturer	PrairieTek	PrairieTek	Conner	Conner	Conner	Conner
Interface	IDE, RLL	IDE, RLL	RLL, IDE	ST-506	IDE	IDE
Average access time (milliseconds)	23	23	25	28	27	25
Controller manufacturer	PrairieTek	PrairieTek	Conner	Conner	Conner	Commax
Hard disk options	None	None	None	40MB	20MB, 100MB	None
FLOPPY DISK DRIVES						
Capacity and size	1.44MB 3.5-inch ($299)	1.44MB 3.5-inch ($299)	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch
Manufacturer	Sharp	Texas Instruments	Toshiba	Sony	Seiko	Commax
EXPANSION BUS						
Bus speeds (MHz)	6, 7.16	6, 7.16	N/A	8	8	8
ISA/MCA/EISA expansion slot	None	None	None	None	None	1 ISA half-length
Proprietary expansion slots	1 modem/CRT	1 fax/modem	1 modem	1 modem	1 modem	1 modem
External expansion port	■	❑	■	■	■	❑
Expansion unit	■ ($699)	❑	■ ($1,199)	■ ($349)	■ ($295)	❑
Self-configuration	❑	N/A	■	❑	■	N/A
Single connection	■	N/A	■	❑	■	N/A
VIDEO						
Video modes supported	VGA, EGA, CGA	VGA, EGA, CGA	Double-scan CGA	CGA, MDA	VGA, EGA, CGA	VGA, EGA, CGA, MDA
Number of gray scales (at maximum resolution)	16	16	2	4	16	16
Interface	16-bit	16-bit	8-bit	8-bit	16-bit	16-bit
Chip set manufacturer	Chips and Technologies	Chips and Technologies	Toshiba	Compaq	Info not available	Chips and Technologies
Supports internal and external displays simultaneously	❑	❑	❑	❑	❑	❑

☆—Editor's Choice ■—Yes ❑—No N/A—Not applicable: the product does not have this feature.

Twinhead Corp. **Twinhead Superlap SX**	Intelligence Technology Corp. **ITC 386 PEP**	Data General Corp. **Walkabout/SX**	Epson America Inc. **Epson Equity LT-386SX**	Compaq Computer Corp. **Compaq SLT 386s/20**	Toshiba America Information Systems Inc. **Toshiba T3100SX**	Zenith Data GRiD Systems Corp. **GRiD 1450sx**	Systems **Zenith TurbosPort 386e**
Sidelit cold-cathode LCD	Backlit page-white LCD	Backlit supertwist LCD	Backlit supertwist LCD	Compensated supertwist LCD	Gas plasma	Backlit supertwist LCD	Compensated supertwist LCD
Twinhead	ITC	Data General	Epson	Compaq	Toshiba	GRiD Systems	Zenith
Chips and Technologies	G2-GC101SX-PC	Chips and Technologies	Epson	Compaq	Toshiba	Chips and Technologies	Zenith
Interleaved page-mode	Row/column	Interleaved, page-mode, row/column	Page-mode	Enhanced page-mode	Row/column	Interleaved	Enhanced page-mode
0	1	0	0	0	1	4	0
80387SX	None	80387SX	80387SX	80387SX	80387SX	80387SX	80387
512K–4MB	2MB–2MB	1MB–8MB	2MB–4MB	2MB–14MB	1MB–13MB	1MB–5MB	2MB–3MB
1MB	2MB	4MB	2MB	6MB	3MB	3MB	3MB
SIMM (80 ns.)	ZIP (120 ns.)	SIMM (100 ns.)	DIP (70 ns.)	DIP (70 ns.)	Proprietary (80 ns.)	Proprietary (100 ns.)	Proprietary (50 ns.)
4x256Kb	1Mb	1Mb	265Kb	Info not available	4x256Kb	1MB	256Kb
None	None	None	None	4K 4-way set associative	None	None	None
Phoenix 1.10 20SX (2/89)	Quadtel 3.04.03 (1990)	Phoenix 1.10.10 (1/88)	Epson (9/89)	Compaq (date not available)	Award/Toshiba 1.2 (10/89)	Phoenix 1.10.10 (4/90)	Zenith 3.2C (date not available)
■ / ❑	■ / ■	❑ / ❑	■ / ❑	■ / ■	❑ / ❑	❑ / ❑	■ / ❑
■ / ■	❑ / ■	■ / ■	■ / ❑	■ / ■	■ / ■	■ / ■	■ / ■
40MB 3.5-inch	42MB 2.5-inch	40MB 3.5-inch	20MB 3.5-inch	120MB 3.5-inch	40MB 3.5-inch	40MB 2.5-inch	40MB 3.5-inch
Conner	PrairieTek	Conner	Conner	Compaq	JVC	PrairieTek	Zenith
RLL, IDE	IDE	IDE	IDE	IDE	IDE	IDE	IDE
25	28	25	25	19	25	28	25
Conner/Cirrus 100MB, 200MB	PrairieTek None	Conner None	Commax 40MB	Compaq 60MB	JVC 80MB	Western Digital None	Zenith None
1.44MB 3.5-inch	1.44MB 3.5-inch ($149)	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch	1.44MB 3.5-inch
TEAC	Y.E. Data	Sony	Epson	Compaq	Toshiba	Epson	Various
N/A	8	8	N/A	N/A	8, 10	8	8
None	None	None	1 ISA half-length	None	None	None	None
1 modem	None	1 modem, 1 CRT/network	1 modem, 1 memory	1 modem	1 modem, 1 fax/network	1 modem	1 modem
■	❑	❑	❑	■	■	❑	■
■ ($399)	❑	❑	❑	■ ($999)	■ ($1,499)	❑	■ ($599)
❑	N/A	N/A	N/A	■	❑	N/A	❑
❑	N/A	N/A	N/A	■	■	N/A	❑
VGA, EGA, CGA, MDA	VGA, EGA, CGA	VGA, EGA, CGA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, MDA	VGA, EGA, CGA, HGA, MDA	VGA, EGA, CGA, MDA
32	16	16	16	16	16	16	8
8-bit	8-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Cirrus	Chips and Technologies	Cirrus	Gemini	Info not available	Paradise	Cirrus	Info not available
■	❑	❑	❑	❑	■	❑	❑

CONTINUES

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MODEL	PREMIUM 386SX/16 (45V)	DESKPRO 386S (40)	PREMIUM 386/25 (115V)	DESKPRO 386/25 (110)	PREMIUM 386/33T (325)	DESKPRO 386/33L (320)	PREMIUM 486/25E (325)	DESKPRO 486/25 (320)	PREMIUM 486/33E (325)	DESKPRO 486/33L (320)
PROCESSOR TYPE/SPEED	80386SX,™ 16 MHz	80386SX, 16 MHz	80386, 25 MHz	80386, 25 MHz	80386, 33 MHz	80386, 33 MHz	i486, 25 MHz	i486, 25 MHz	i486, 33 MHz	i486, 33 MHz
HARD DISK STORAGE	40 MB	40 MB	110 MB	110 MB	320 MB	320 MB	320 MB	320 MB	320 MB	320 MB
LANDMARK RATING	23[1]	15[1]	39[1]	41[1]	53[2]	N/A	114[2]	111[2]	140[2]	N/A
UPGRADE-ABILITY	YES	NO	YES	NO	YES	YES	YES	NO	YES	YES
DIRECT SUPPORT	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
LIST PRICE	$3,195	$3,699	$5,995	$8,499	$8,795	$12,499	$10,295	$14,999	$11,795	$16,499

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[1] Run with Landmark 1.10. [2] Run with Landmark

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PORTABLE PCs: SUMMARY OF FEATURES

	Sharp Electronics Corp. **Sharp PC-6220**	Texas Instruments Inc. **TravelMate 2000**	Toshiba America Information Systems Inc. **Toshiba T1200XE**	Compaq Computer Corp. **Compaq LTE/286**	Arima Computer Corp. **Arima ACT 386SX-420**	Impulse Systems Inc. **Impulse SX**
KEYBOARD						
Number of keys	79	79	82	81	82	82
Function keys	12	12	12	10	12	12
Cursor keys	4	4	8	4	4	4
Keyboard cable length (inches)	N/A	N/A	N/A	N/A	36	20
External keyboard connector	Optional ($299) †	Optional ($299) †	❑	❑	■	■
SOFTWARE						
DOS	4.01 (included)	4.01 (included)	4.01 (included)	3.31 ($120), 4.01 ($150)	4.01 (included)	4.01 (included)
OS/2	None	None	None	1.1 ($340)	None	None
Disk caching software	None	None	*PC-Kwik Power Pak*	*Compaq Disk-Cache Utility*	None	None
Expanded memory manager	None	None	None	CEMMP	Chips and Technologies EMM.SYS	None
Other	*Laplink* 2.04	*Laplink* 2.04	None	None	None	*Arriba* 1.01 (PIM)
MODEM						
Internal modem (price)	2,400 bps (price not available)	2,400 bps ($499)	2,400 bps (price not available)	2,400 bps ($449)	2,400 bps ($199)	2,400 bps ($249)
MNP 5 compression	■	■	■	❑	❑	❑
V.42 error correction	❑	❑	■	❑	❑	❑
V.42 bis compression	❑	■	■	❑	❑	❑
Modem options	Fax modem (price not available)	None	None	None	Fax/modem ($299)	Fax/modem ($359)
PHYSICAL FEATURES						
Power supply (watts)	7.3 (average), 17.3 (maximum)	7.3 (average), 17.3 (maximum)	50	14.75	55	40
Dual voltage	■	■	■	■	❑	■
Power-on switch	Front	Front	Rear	Front	Rear	Rear
Reset switch	None	None	Rear	None	Front	None
BATTERY						
Claimed battery life	2 hours	2 hours	2 hours	3.5 hours	2.5 hours	2 hours
Battery charge time	2 hours	2 hours	4 hours	9 hours	3 hours	2 hours
Battery voltage and Amp/hours	9.6V, 1.2Ah	9.6V, 1.2Ah	12V, 2.2Ah	4.8V, 5Ah	12V, 2.5Ah	7.2V, 1.2Ah
Battery conservation techniques	Display, disk, and system shutdown	Display, disk, and system shutdown	Screen blanking, disk shutdown, modem off	Display, disk, and system shutdown	Display and disk shutdown	Display and disk shutdown, CPU slowdown
Standby or auto-resume mode	■	■	■	■	❑	❑
Transformer weight (lbs.)	0.9	0.9	1.3	1.4	1.5	1.1
Transformer size (inches)	3.5 x 6.5 x 1.4	3.5 x 6.5 x 1.4	3 x 5.5 x 1.5	3.1 x 5.1 x 2.1	2 x 6.5 x 3	3.3 X 7.8 X 2.3
Transformer cord length	10 feet	10 feet	6 feet 7 inches	10 feet	8 feet	3 feet 6 inches
Car battery adapter available	❑	❑	■	■	■	❑
MISCELLANEOUS						
Price of carrying case	$69	$90	$99	$39	$99, leather $169	$119
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
Service	Return to manufacturer	Return to manufacturer	Return to dealer or manufacturer	Return to dealer	Return to dealer	Return to dealer or manufacturer
FCC Class B certification	■	■	■	■	❑	■

❑—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.
†—On clip-on floppy disk drive.

Twinhead Corp. **Twinhead Supertap SX**	Intelligence Technology Corp. **ITC 386 PEP**	Data General Corp. **Walkabout/SX**	Epson America Inc. **Epson Equity LT-386SX**	Compaq Computer Corp. **Compaq SLT 386s/20**	Toshiba America Information Systems Inc. **Toshiba T3100SX**	Zenith Data GRiD Systems Corp. **GRiD 1450sx**	Systems **Zenith TurbosPort 386e**
83	77	86	82	82	86	82	79
10	10	12	12	12	12	12	12
8	4	8	4	4	■	8	8
40	N/A	N/A	N/A	24	N/A	N/A	25
■	❑	❑	■	■	Optional ($199)	■	■
4.01 (included)	3.3 (included)	4.01 (included)	4.01 (included)	3.31 ($120), 4.01 ($150)	4.01 (included)	3.3, 4.01 ($150)	4.01 (included)
None	None	None	None	1.1 ($340)	1.1 ($325)	1.21 ($495)	1.1 ($339)
Super PC-Kwik (Twinhead version)	None	None	None	None	*PC-Kwik Power Pak*	None	None
LIM 4.2 in BIOS	None	*QEMM-386*, Rev. 5	None	None	*QEMM-386*	*386MAX*	None
None	*Mirror II*	None	None	None	*Windows* 3.0 (included)	None	None
2,400 bps ($249)	2,400 bps (included)	2,400 bps ($395)	2,400 bps ($299)	2,400 bps ($599)	2,400 bps ($349)	2,400 bps ($595)	2,400 bps (included)
■	■	■	❑	■	❑	■	❑
❑	❑	❑	❑	■	❑	❑	❑
❑	❑	❑	❑	■	❑	❑	❑
None	Cellular modem ($279)	None	None	None	External Expansion Unit modem ($299)	Fax/modem ($495)	None
40	54	40	40	20	60	50	40
■	■	❑	■	■	■	❑	■
Side	Top of keyboard	Side	Rear	None	Side	Rear	Rear
Top	None	None	None	None	Side	None	None
2–2.5 hours	2 hours	3–5 hours	3 hours	3 hours	3 hours	2 hours, $299; 4 hours, $399	2.5–3 hours
4 hours	4 hours	8 hours	16 hours	3 hours	3 hours	2.5 hours/ 3.5 hours	2 hours
12V, 4.5Ah	7.2V, 3.5 Ah	12V, 3.4Ah	9.6V, 4Ah	12V, 2.4Ah	9.6V, 2.4Ah	9.6V, Ah info not available	24V, 2.1Ah
Manual standby mode	Display and disk shutdown	Display and disk shutdown	Display and disk shutdown	Display and disk shutdown	Display, disk, and system shutdown	Display and disk shutdown	Display and disk shutdown, CPU slowdown
■	❑	❑	❑	■	■	■	❑
1.5	2	2.6	0.8	1.7	1.7	1.6	1.3
3 x 6.5 x 2	1.5 x 2.5 x 7	3 x 6.5 x 2.5	3.3 X 7.8 X 2.3	2.4 x 3.4 x 8.6	3.1 X 6.9 X 2.2	5.4 x 2.75 x 1	3 x 6.25 x 2
13 feet	8 feet	6 feet	5 feet	6 feet 7 inches	11 feet 6 inches	6 feet	8 feet
❑	■	■	❑	❑	❑	■	❑
Included	N/A	$80, leather $245	$99, leather $199	$89	$99	$60, leather $180	$79
1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
On-site service	Return to manufacturer	Return to manufacturer	Return to dealer or manufacturer	Return to dealer or manufacturer	Return to dealer or manufacturer	Ship to manufacturer	Return to dealer or manufacturer
■	❑	■	■	■	■	■	■

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FACT FILE
EDITOR'S CHOICE

TravelMate 2000
Texas Instruments Inc., P.O. 202230, Austin, TX 78720-2230; (800) 527-3500.
List Price: With 1MB RAM, 20MB hard disk, triple supertwist VGA liquid crystal display, one parallel and one serial port, an AC adapter, DOS 4.01, *LapLink* 2.04, $3,999; with 2MB RAM, external 1.44MB 3.5-inch floppy disk drive, $4,847.
In Short: Essentially the same machine as the Sharp PC-6220 (barring a few cosmetic changes), the TravelMate 2000 is just as impressive. Configured as a base-priced 286 system with 1MB RAM, 20MB hard disk, and 2-hour battery, it gives you a lot of computing for only 4.4 pounds.

CIRCLE 429 ON READER SERVICE CARD

return a defective unit for service. In addition, Texas Instruments will sell you an overnight exchange policy for your unit for $84 per year and an on-site policy for $132 a year. If you are looking for a laptop machine that can give you everything you need—and spare you a sore shoulder—look no further than the Sharp PC-6220 or the TravelMate 2000.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T1200XE

by Salvatore P. Ricciardi

With the $3,999 T1200XE, Toshiba supplies a carryable, comfortable machine that sits squarely between the familiar 8086-based T1200HB and Toshiba's 80286-based EGA-compatible T1600.

Weighing in at 8.3 pounds, including a 20MB hard disk, the unit is Toshiba's lightest 286-based laptop. Based on a 12-MHz 80C286 processor contained in a 2-inch-high case, this sturdy portable is slightly larger than the typical notebook, though Toshiba would prefer you to think of it as one. Unfortunately, positioning this machine below the T1600 forced Toshiba to make some compromises, such as the T1200XE's use of a CGA display and its lack of a 40MB hard disk option.

Toshiba has again passed down its high standards in keyboards for its family of battery-powered laptops to the new T1200XE. This model upholds Toshiba's tradition of exceptional keyboards that sacrifice little to portability.

The laptop arrived at PC Labs in its standard configuration, including 1MB RAM, a 20MB hard disk, one 1.44MB 3.5-inch floppy disk drive, one parallel printer port, one 9-pin serial port, one CGA/RGB monitor port, a port for an optional dedicated numeric keypad ($99), a slot for an optional internal modem ($349), and a 100-pin external bus connector for Toshiba's Deskstation unit (not available as of this writing). Toshiba's own version of DOS 4.01 and various utilities are also included. Unfortunately, Toshiba does not include the carrying case ($99) as standard equipment.

You can expand the unit's 1MB of standard 80-nanosecond RAM up to 5MB in 2MB chunks for $1,099 each. The machine has two dedicated memory expansion slots available for this purpose. Our test unit came outfitted with 3MB RAM, jacking the price up to $5,098. You'll have several options for the extra RAM, including HardRam, which is like a RAM disk except that it's nonvolatile, meaning it will retain its contents between power-downs.

The quality of the display is improved by a sidelit supertwist LCD screen. Using double-scan CGA, the display has a maximum resolution of 640 by 400 dots per inch. That's a considerable improvement over the backlit, single-scan screen technology used in the T1200HB; it has a maximum resolution of 640 by 200. The crisp text is gentle on the eyes, and for text-only applications, it's hard to complain about the T1200XE's screen.

But the CGA display dates the machine. As the world moves quickly past VGA and even beyond Super VGA, the need for a laptop screen with more than the T1200XE's two shades of gray grows more apparent. The double-scan technology of the T1200XE, which increases resolution from the standard CGA 640 by 200 maximum, positions this laptop nicely below the T1600's EGA display in Toshiba's lineup. But the truth is that they both need an upgrade.

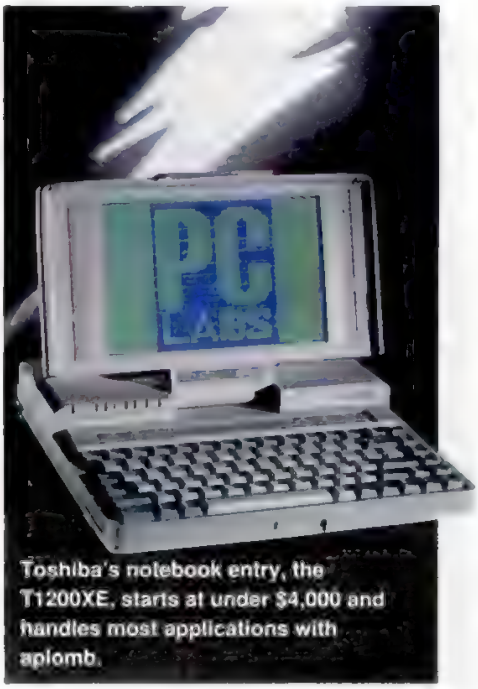
The Conner Peripherals 20MB 2.5-inch hard disk has a small enough form factor to keep the unit's weight down while supplying 25-millisecond average access time—quite acceptable for a battery-powered 286-class machine. The package comes with *PC-Kwik Power Pak* utilities, including the *Super PC-Kwik* disk cache, which is configurable to extended memory. On the downside, there is no option to upgrade to a 40MB hard disk.

The keys are nicely sculpted, not flattened like some, with excellent response. You won't have to work hard while touch-typing on this keyboard. Toshiba still has the sense to dedicate keys—Home, PgUp, PgDn, and End—to the cursor keypad, while locating them where you'd expect.

A dedicated function key gives you access to the T1200XE's special functions, such as the numeric keypad overlay that's embedded in the right center of the keyboard. You can also use the overlay to switch between single- and double-dot fonts or between the internal and external displays. Unfortunately, there is no automatic way to select the alternate font through your AUTOEXEC.BAT file. To change fonts, you have to wait for the machine to boot and enter the correct sequence through the keyboard.

A few design oversights make maneuvering more difficult than necessary. The flap for lifting the screen from its closed position is difficult to manipulate and flimsy. The brightness and contrast controls are equally difficult to maneuver since they are set practically flat within the panel surrounding the display. And the two legs in back can lift the unit up at an angle but are a little stubborn.

The unit's removable nickel cadmium battery is rated for about two hours. In PC Labs' Battery Rundown test, the T1200XE lasted for 2 hours and 20 minutes on a full charge, which takes about 4 hours if you're not working on the machine while recharging. The batteries weigh 15.5 ounces



Toshiba's notebook entry, the T1200XE, starts at under $4,000 and handles most applications with aplomb.

each (included in the unit's stated 8.3 pounds), so carrying a spare pack ($129) shouldn't be too difficult.

If you tend to cut it close where battery life is concerned, the T1200XE has several wonderful battery conservation techniques. There's automatic power-down of the hard disk, the display, and the CPU. If you're frequently interrupted, you'll like Toshiba's AutoResume feature, which ought to be standard on all personal computers. This function lets you shut the machine off, turn it back on, and return automatically to where you left off. AutoResume enables itself when the battery discharges in the middle of an application.

All things considered, the T1200XE is a logical step up from the T1200HB. If you can live without VGA and compromise with a 20MB hard disk limit, the merits of this machine will please you.

FACT FILE

Toshiba T1200XE
Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Boulevard, Irvine, CA 92718; (714) 583-3000.
List Price: With 1MB RAM, 20MB hard disk, CGA double-scan sidelit supertwist LCD, 1.44MB 3.5-inch floppy disk drive, one parallel and one serial port, DOS 4.01, *PC-Kwik Power Pak*, $3,999; with 3MB RAM, $5,098.
In Short: A comfortable, lightweight clamshell that'll do just fine for text applications but lacks hard disk options. If you're looking for more than two gray shades, look elsewhere.

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386- AND 386SX-BASED PCS:

ARIMA COMPUTER CORP.

Arima ACT 386SX-420

by Bruce Brown

If you can bear the weight of a traditional laptop in the battery-powered arena but won't make any other compromises, the Arima ACT 386SX-420 may be the machine for you. Whether you're looking for price, expandability, performance, overall quality, or all of the above, this unit does well on every score.

The ACT 386SX looks exactly like the Compaq SLT 386s/20 and comes equipped with a 16-MHz 80386SX processor. At 13.66 pounds with battery—excluding the 1.48-pound AC adaptor—this 3.9- by 13.9- by 8.7-inch clamshell-design laptop requires its own case for carrying comfort. At press time, however, the FCC would not confirm the machine's Class B certification.

The ACT 386SX's component mix and price are both right on target. The $2,895 basic configuration includes 1MB RAM, a 40MB Conner hard disk, one 3.5-inch 1.44MB floppy disk drive, a VGA liquid crystal display, one parallel and two serial ports, ports for an external floppy disk drive and an external monitor, a removable keyboard, and DOS 4.01. Our tested unit, which came with 2MB RAM, an internal 2,400-bit-per-second modem, and an external docking station with two 16-bit expansion slots, was still a competitive $3,470.

Equipped for good performance, the ACT 386SX has a Chips and Technologies NEAT 386SX chip set, AMI ROM BIOS, system ROM BIOS shadowing, and a slot for an 80387SX math coprocessor. As the benchmark test results show, Arima's laptop scored well for a 16-MHz SX machine with an 8-MHz I/O bus.

Internal memory expansion is limited to 4MB, using 1MB 80-nanosecond SIMMs. If you use the docking station with a 16-bit memory expansion board, you can increase the system memory to 16MB, but of course that's only when you're hooked up to the docking station. Although you wouldn't want to carry the docking station on the road, the $295 price of this option is reasonable enough that you may want to keep one station in the office and one at home. Of course you'd have to add the cost of a memory board and chips to get the full picture. The point is, however, that you can have a full 16MB at your usual stationary locations and still take 4MB on the road.

When Compaq's SLT made its debut with a VGA LCD, it was widely praised. The Arima's display is just as good. It's a backlit supertwist display capable of 16 shades of gray. You may have to adjust for brightness and contrast when running an applications program with several colors. The generous 7.9- by 4.5-inch screen affords a 1.62 aspect ratio, which causes just a little circle squashing but is still quite acceptable for graphics.

The ACT 386SX's keyboard is also similar to the SLT's. You can use the keyboard right where it is or detach it and move back a bit with its 3-foot cable. The keyboard has 82 keys, all full-sized, with a special function key used for the embedded numeric keypad and the page-movement keys that share key space with the inverted-T-formation cursor-control keys. In case you'd rather use a full-size keyboard at home or in the office, the keyboard port accepts standard PS/2-style keyboard plugs. An AT-style keyboard-connector adapter is included.

The ACT 386SX runs on either the AC adapter or the rechargeable 2.5-Amp/hour nickel cadmium battery pack. In our rundown tests, the batteries lasted an acceptable average of 1 hour 49 minutes. A full recharge takes 3 hours, but in just 1 hour you can get a 90 percent "quick charge." The battery pack weighs 1.66 pounds; extra units cost $89 each. An optional external battery charger capable of charging two batteries at once is also available and lists for $99.

Battery power conservation features include a nonsettable 4-minute screen power-down and 3-minute hard disk power-down. The system can't power-down the keyboard, ports, or memory, capabilities that would make for truly impressive power conservation. When the battery can no longer run the rest of the system, however, a system memory mode maintains the memory contents for 10 minutes, which is certainly enough time

Priced under $3,000, the Arima ACT 386SX-420 is sturdy enough to be your only computer.

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FACT FILE

Arima ACT 386SX-420
Arima Computer Corp., 15775 North Hillcrest, #508, Dallas, TX 75248; (214) 404-9119.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA backlit supertwist liquid crystal display, one parallel and two serial ports, external floppy disk drive port, external VGA port, AC adapter, DOS 4.01, $2,895; with 2MB RAM, $2,995; with 2,400-bps modem, docking station with two 16-bit slots, $3,470.
In Short: Arima's ACT 386SX-420 is a Compaq SLT clone at a bargain-basement price and with relatively affordable expansion options. As of press time, however, FCC-B rating was pending. This sturdy 14-pound laptop has a good enough screen, keyboard, and array of options to be your only computer once FCC certification is approved.

CIRCLE 543 ON READER SERVICE CARD

to find and plug in the AC adapter or shut off the machine until you can install a charged battery.

The system's standard 40MB 24-millisecond hard disk will be sufficient for many portable users, but just in case, Arima intends to offer 80MB and 100MB options by this fall. In addition to the internal 1.44MB floppy disk drive, there's a port on the back into which you can plug an optional $225 1.2MB 5.25-inch floppy drive.

If you purchase the docking station you can add a hard card or use one of the two slots for an interface card for an external tape backup unit. Assuming that you didn't want to use one of the docking station's slots for a memory expansion card, you could set up the ACT 386SX to have two hard disks, two floppy disk drives, and a tape drive.

Arima sells only to dealers, not to distributors and not directly to end users. The vendor says you can probably expect the average discount to be between 15 and 20 percent. If you have a problem with an ACT 386SX during the one year covered by the parts-and-labor warranty, you can return the machine to your local dealer for service. At press time, an on-site service contract was in preparation but was not yet finalized.

Although present technology makes a lighter-weight ACT 386SX unlikely for a while, today's Arima laptop offers a terrific component package in a totable form at a price that catches your attention. If you want it all and want to take it with you, look closely at the Arima ACT 386SX.

COMPAQ COMPUTER CORP.

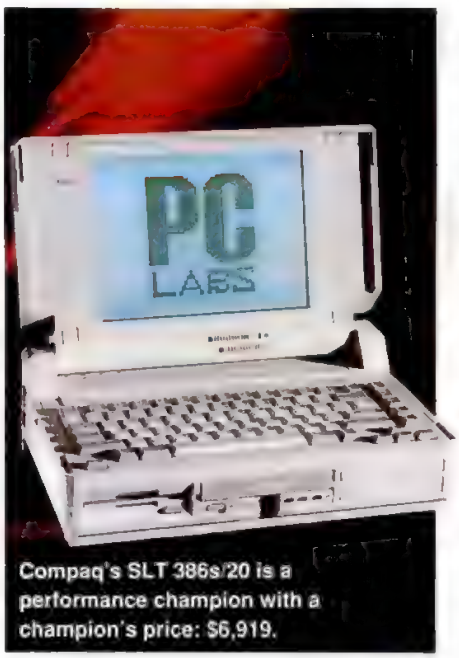
Compaq SLT 386s/20

by Bill O'Brien

No one is about to praise the Compaq SLT 386s/20 for its inexpensive price. Performance from this portable is a sheer delight, however, pushing it to the top of the list of 80386SX portables tested.

Charging $6,799 for the basic-configuration Model 60 with 2MB of RAM, a 60MB hard disk, a single 3.5-inch floppy disk drive, and a high-resolution monochrome VGA liquid crystal display, Compaq has upped the ante in the portable computer market. Its ace in the hole is the brain of the SLT 386s/20, which is one of the new breed of 80386SX chips running at 20 MHz and ably assisted by 4K of processor RAM cache. The 13.92-pound, 8.5- by 14.5- by 8.25-inch SLT 386s raises the stakes on portable computing in more ways than one.

Our standard configuration adds DOS to the base-priced Model 60, raising the cost to $6,919. For review, Compaq submitted an upgraded version, the Model 120, containing a 120MB hard disk with 17.82-millisecond average access time. It's the only portable reviewed here equipped with this much storage capacity. Doubling the hard disk size adds $700 to the portable's price, and the added data space is well worth the cost.



Compaq's SLT 386s/20 is a performance champion with a champion's price: $6,919.

FACT FILE
EDITOR'S CHOICE

Compaq SLT 386s/20
Compaq Computer Corp., 20555 State Hwy. 249, Houston, TX 77070; (800) 231-0900, (713) 370-0670.
List Price: Model 60, with 2MB RAM, 60MB hard disk, 1.44MB 3.5-inch floppy disk drive, monochrome VGA liquid crystal display, $6,799; with DOS 3.31, $6,919. Model 120, with 2MB RAM, 4MB expansion board, 120MB hard disk, 1.44MB 3.5-inch floppy disk drive, monochrome VGA liquid crystal display, DOS 3.31, $10,218.
In Short: The SLT 386s/20 is a champion in performance that comes with a champion's price for its 20-MHz 80386SX technology. The worst thing that can be said about this road warrior is that it's worth the price.

CIRCLE 544 ON READER SERVICE CARD

Perhaps harder to understand is the reviewed machine's memory expansion cost. The machine arrived at PC Labs boosted to 6MB by the addition of one of Compaq's 4MB expansion boards. We doubt whether this addition is a likely one for most prospective SLT 386s owners unless they have an open line of credit. The bump in memory adds $2,599 to the price and brings the total for this expanded Model 120 to $10,218.

For this money, you should expect superb performance, and Compaq delivers. Our tested model offers more battery time than any of the other machines we tested—3 hours 38 minutes—and beats the other 286s and 386SXs in every benchmark test.

The SLT 386s does retain some of the faults ascribed to its predecessor, the Compaq SLT 286. Chief among them is the video display. Like the earlier model, the SLT 386s's video is VGA-capable and ultrafast. The high-resolution LCD screen produces superb graphics and character displays but does so through a very hazy band of visibility. While not difficult to read, the screen is hard to concentrate on.

The default display mode, with white characters on a dark background, is chiefly responsible for the visual incongruity. To the company's credit, Compaq has included a ROM setup option to reverse the display and deliver dark characters on a light background. Switching to this mode makes text work actually enjoyable, but graphics appear in reverse video: what should be black is white and vice versa. Strike two for the video is the SLT 386s's inability to display simultaneous images on its own screen and on an external VGA

From The Arche™ Design Lab

Graphic Workstations The Next PC Frontier

Second in a series on high performance systems
by Joe Kua, Director of R&D, ARCHE TECHNOLOGIES, Inc.

Graphic workstations move a tremendous amount of data between video and memory. This segment of our series on high performance systems explains how Arche Legacy and Pro-File 80386-33 Mhz and 80486 models were optimized for efficient vector processing, floating point, perspective calculation and high speed video.

"Taking the time to develop a high performance video adapter assured a level of compatibility and expandability that can't be matched in a system with video implemented on the motherboard; such as with Compaq's 386-33"
Joe Kua

To gain an edge in video performance, we chose to develop our own video adapter, rather than implementing video on the motherboard. While implementing video circuitry on the motherboard increases performance and costs less to manufacture, it can conflict with AT design rules, compatibility and does not address or allow for rapid changes or enhancements in video technology.

For maximum performance, our VGA adapter uses a 32 byte First In, First Out (FIFO) data path on both the bus and video side of the adapter. FIFO provides a dramatic improvement in video performance over direct memory access as it enables the use of DRAM as a video buffer instead of slower VRAM. This allowed us to take advantage of the performance characteristics of DRAM, including paging to increase bus bandwidth into and out of display memory.

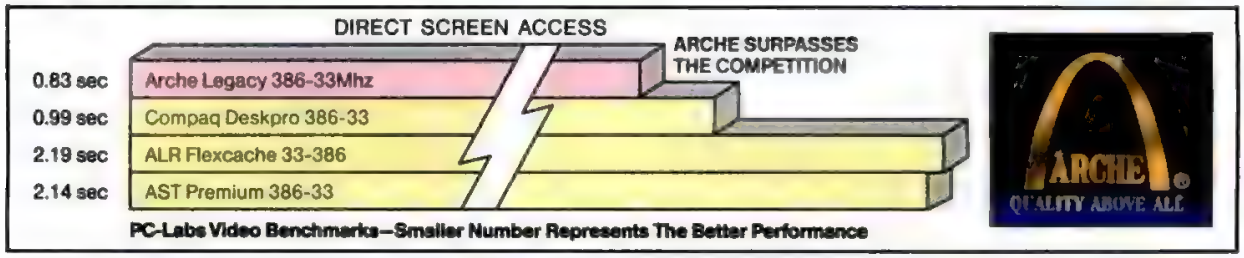
With FIFO, our VGA adapter gains a cache on both the bus and video side, a 1:1 interleave, 0 wait states and the ability to implement burst modes between the video buffer and display. The adapter is both register and BIOS level compatible with IBM VGA and the design offers several extended graphic resolutions up to 1024 x 768 in 256 colors.

From a memory standpoint, our exclusive mainframe style memory subsystem, with ProCache,™ enhances the performance of classic AT and even EISA architecture, without sacrificing compatibility. With ProCache, memory management is optimized by freeing the CPU of tasks associated with regulating data between cache, main memory and direct memory access (DMA) devices, like drives and tape back-up. For graphic applications this reduces microprocessor interrupts and increases throughput and processing stability.[1]

Unlike PC memory subsystems based on a write through architecture, such as those using the Intel 82385, Arche Legacy and Pro-File models, with their "flagged register copy back" design further improve throughput when running graphic applications. That's because with a write through architecture, data concurrency between cache and main memory is assured by writing through to main memory on every cache write. As vector processing, floating point and perspective calculation are all write intensive, posting for data concurrency in this manner, actually bogs down the CPU given a series of unnecessary and redundant writes. Using a flagged register copy back architecture, on the other hand, posting from cache to main memory is only initiated when ProCache ascertains that emended data is required to satisfy a DMA request.

At our R&D center, and among a growing number of power users, the benefits of our design effort are now known. The Legacy and Pro-File 386-33 can run 36 concurrent sessions in 36 windows at 8.3 MIPS and 1,528 whetstones. And for Unix, the Arche Legacy 386-33 offers performance that rivals Compaq's SystemPro.[2] At Arche we consider this quality well implemented. An essential factor when your quest is to provide Quality Above All.

Arche high quality, American made computer systems are available at exclusive, authorized Arche dealers. For the location of the one nearest you, Call 1-800-422-4674, or use the reader response number printed in this publication.



Arche high performance VGA adapter is optional. Arche name and Logo are registered trademarks, Quality Above All, Legacy, Pro-File and ProCache are trademarks of Arche Technologies, Inc. All other names are trademarks of their respective companies. Arche Technologies, Inc. 1990.

[1]See Personal Workstation, Arche Brings Mainframe Stability to PC FileServer, Great Performers and Proving Ground May, 1990, pg. 22, 23, 65, 69

[2]Base Model

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CIRCLE 317 ON READER SERVICE CARD

BENCHMARK TESTS: 286-BASED PORTABLES

PC LABS

Since the only significant differences among these notebooks are in weight and design, not performance, you won't go wrong in choosing any of these systems.

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

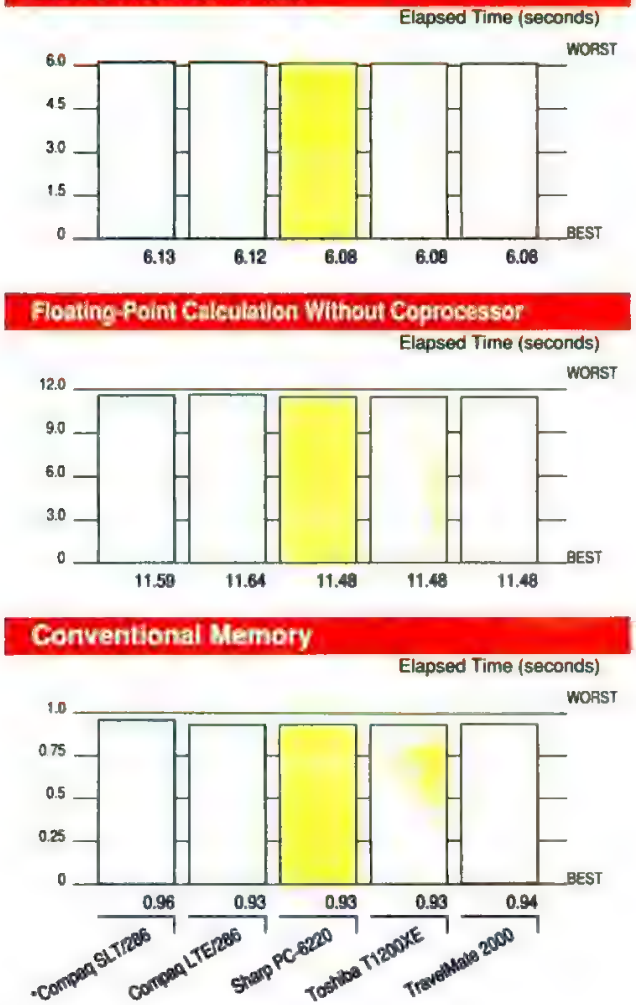
The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

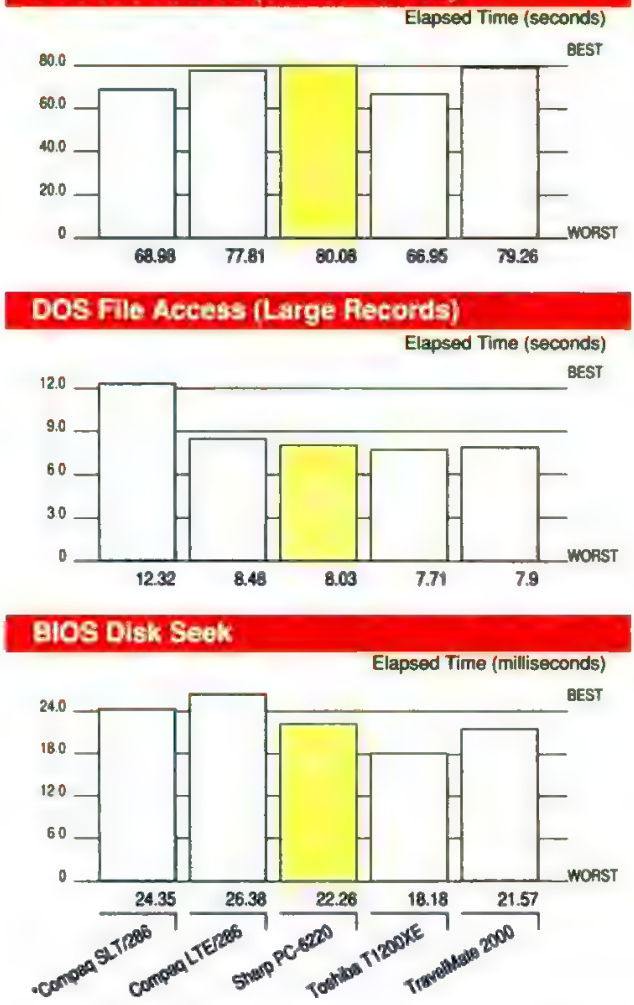
PROCESSOR AND MEMORY BENCHMARK TESTS

80286 Instruction Mix



DISK BENCHMARK TESTS

DOS File Access (Small Records)



* Reported for comparison.

CONTINUES

monitor. If you use the machine for demonstrations, you won't see your application on both the laptop screen and the external monitor.

Another legacy is the SLT 386s's detachable typewriter-style keyboard. Compaq has hit the mark squarely. Key sizes and spacing are all standard for a desktop equivalent, apart from the inclusion of four cursor keys rather than eight. Even the twelve function keys are laid in across the top without confusion. But because Compaq is attempting to provide all of the cursor-control keys as well as to simulate the numeric keypad found on 101- and 102-key keyboards, each function key controls up to four functions.

Compaq's optional ($999) docking station—the Desktop Expansion Base, with its two 16-bit slots—does credit to the SLT 386s. It attaches to a port at the rear of the machine and replicates the parallel, serial, external keyboard, and external monitor connectors that would otherwise be covered by the docking station once it was installed. And the SLT 386s is one of the few portables that could intelligently be considered for double duty as a desktop computer.

If you must own the latest in high-performance SX technology, you are not going to find better in a portable, despite the screen and keyboard shortcomings of the Compaq SLT 386s/20. But its ability to do tough work and survive tough times comes with a price tag that might be too tough to swallow if you're looking to expand either the Model 60 or the Model 120 above its basic configuration.

DATA GENERAL CORP.

Walkabout/SX

by Bruce Brown

Data General's Walkabout/SX doesn't break any records or raise any eyebrows with new technology. Instead, it's a solid entry in the battery-operated, full-size laptop category. It weighs almost 16 pounds with a 3-hour battery or 14.5 pounds with the AC power adapter. The Walkabout/SX's processor, screen, and expansion capability let you tote most of the power you would expect from a desktop computer.

Listing for $5,395, the standard Walkabout/SX comes with a 16-MHz 80386SX processor, 2MB RAM, a 40MB 25-millisecond hard disk, one 1.44MB floppy disk drive, a VGA video adapter, a supertwist backlit VGA LCD, one parallel and two serial ports, external VGA and numeric keypad ports, DOS 4.01, and Quarterdeck Office Systems' *QEMM-386*. Our test system was upgraded to 4MB RAM with an internal 2,400-bps MNP Level 5 modem and a nylon carrying case, raising the list price to $6,470.

Data General equips the Walkabout/SX with its own motherboard using an 80386SX chip set from Chips and Technologies and the common Phoenix 80386 ROM BIOS Plus, Version 1.10.10, which supports selectable system and video ROM BIOS shadowing. The disk-based setup program sets both ROM shadowing and zero or one wait state. The motherboard also has a slot for a 16-MHz 80387SX math coprocessor.

The Walkabout/SX's scores on the PC Labs benchmark tests are right where they should be for this class of computer. The Battery Rundown test resulted in a total time of 2 hours 51 minutes—an excellent score for a machine with a 386SX processor, especially if you bear in mind that we turned off all battery conservation features.

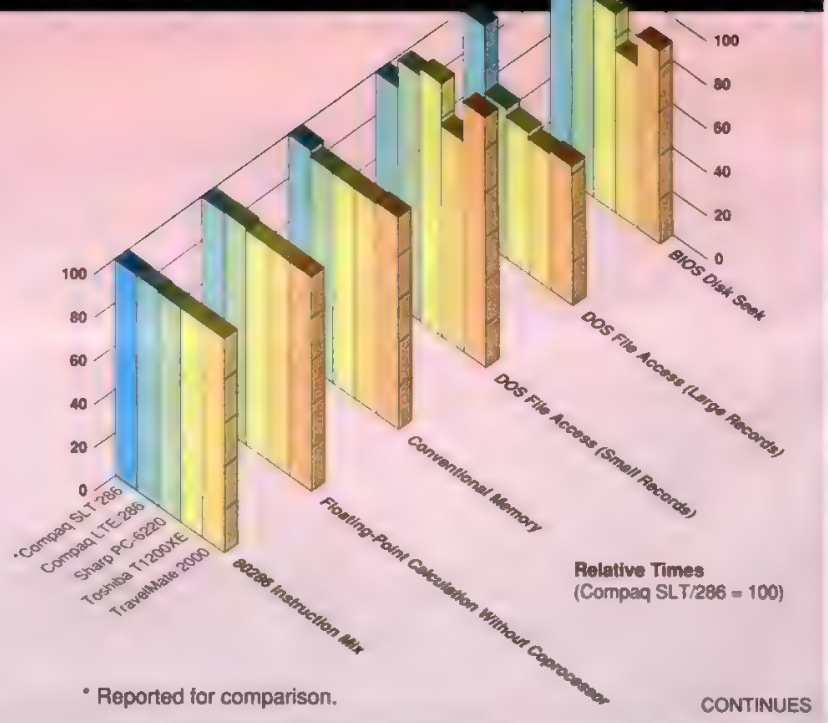
Data General claims 3 to 5 hours operation on a fully charged battery, which is realistic if you use the suite of power conservation features. Through a utility program, you can specify shutdown intervals for both the screen and hard disk. If

PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

Each of the 80286-based portables we reviewed bested the overall performance of the old IBM PC AT, but none emerged as a clear victor in its own right. Even Compaq's LTE/286 has settled into the background of this monochromatic palette of benchmark test scores. Perhaps the only bright spot rests with the Toshiba T1200XE and its hard disk, but the difference is not outstanding. All of these machines contain Conner hard disks rated at 25 milliseconds average access time.

What the numbers don't tell is that the members of this group reflect two distinct portable philosophies. Compaq and Toshiba are the relative heavyweights, at 7.25 and 8.5 pounds, respectively, while the identical Sharp and Texas Instruments (TravelMate) portables weigh in at 4.4 pounds in their best trim traveling form. Pricing is not likely to be a significant factor, with a mere $4 difference between the Compaq and Toshiba, and likewise a $4 difference between the Sharp and TI machines.

With design philosophies being the only determinant here, a choice among the four rests squarely with your preference (or with the executive decision maker). Heads or tails, there's no loser in the bunch.



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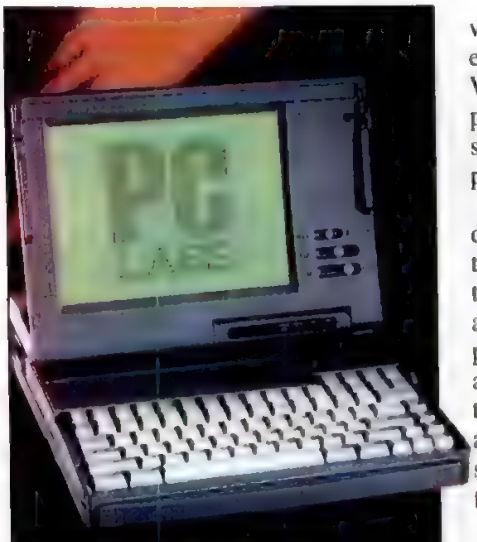
you also use RAM shadowing and run the processor at its slower 8-MHz speed (a default on battery power), your battery times should be greater than the PC Labs test times. The battery is removable, and extra 2.57-pound battery packs cost $125 each.

All memory for the Walkabout/SX plugs into the motherboard. The system maximum is 8MB using 100-nanosecond 1MB interleaved page-mode SIMMs. Extra memory is relatively expensive—$400 for a 1MB upgrade, $600 for 2MB.



Data General's Walkabout/SX ($5,395) showed impressive endurance in PC Labs' battery rundown tests.

The Walkabout/SX's supertwist backlit display provides a reasonably bright screen. Three front-mounted controls let you adjust brightness, contrast, and videoreverse to switch foreground and background shades. The screen displays an image that is 8.25 inches wide by 5.25 inches high, with a slightly squashed 1.70 aspect ratio. Resolution is standard 640 by 480 VGA.

The 86-key keyboard has an embedded numeric keypad and separate keys for cursor and page movement, but no shift-free asterisk key. The keys have normal horizontal and key spacing, but the back two rows curve up a bit, making them seem closer than they are.

The Walkabout/SX's internal 3.5-inch hard disk is a Conner IDE interface model CP3044, the same 25-millisecond 40MB hard disk you'll find in many laptop computers. Sony supplies the dual-density 1.44MB floppy disk drive.

The machine is bit heavy to carry, but there are compensating benefits: the two Data General proprietary expansion slots, one 8-bit and one for 8-bit or 16-bit cards. The limitation of these slots to nonstandard interface cards cuts down somewhat on the computer's claim to expandability. Our test machine's modem took up one of the slots. Data General currently sells a $550 StarLAN network card and $695 bar code reader card and this fall will have an expansion chassis card.

Data General says some third-party vendors and VARs (value-added resellers) sell interface cards that work in the Walkabout/SX and other Data General portable computers, but standard expansion slots would be a greater benefit than proprietary slots.

Data General sells the Walkabout/SX directly and through VARs and distributors. Any machine sold through distributors and dealers can usually be acquired at a 20 to 25 percent discount off the list price, a factor to consider with the Walkabout/SX's slightly-beyond-$5,000 price tag. The Data General system comes with a one-year parts-and-labor warranty, with service provided at the Massachusetts factory.

With an external monitor attached, the Walkabout/SX is powerful enough to use as a desktop machine, with the added convenience of portability for occasional trips. You probably won't want to carry this machine back and forth to work every day or use it as a constant computing companion. By virtue of its expansion potential, good battery life, and appealing screen and keyboard combination, however, the Walkabout/SX is a viable portable candidate for those who want a full-featured machine.

FACT FILE

Walkabout/SX
Data General Corp., 4400 Computer Dr., Westboro, MA 01580; (800) 328-2436, (508) 366-8911.
List Price: With 1MB RAM, a 40MB hard disk, a VGA supertwist backlit liquid crystal display, 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, DOS 4.01, *QEMM-386* 5.0, $4,995; with 2MB RAM, $5,395; with 4MB RAM, internal 2,400-bps modem, carrying case, $6,470.
In Short: The Walkabout/SX is a hefty 15.75-pound, battery- and AC-powered 386SX laptop with two proprietary expansion slots, a 40MB hard disk, and a VGA LCD screen. With the standard battery pack, the Walkabout/SX lasted almost 3 hours on the PC Labs battery tests—very good by current standards.

CIRCLE 545 ON READER SERVICE CARD

EPSON AMERICA INC.

Epson Equity LT-386SX

by Bill O'Brien

Easy expansion is the hallmark of the Equity LT-386SX from Epson. At $5,598, though, versatility is not cheap.

For a base price of $4,599, Epson's portable Equity LT-386SX effectively fits most of the processor power of its desktop Equity 386SX into the smaller confines of this lightweight tagalong.

The Epson Equity LT-386SX arrives in its basic configuration as a 2MB RAM portable with a single 1.44MB 3.5-inch floppy disk drive powered by an 80386SX processor running at 16 MHz. (You can also run the LT-386SX at 8 MHz.) Staples include DOS 4.01, power-saving utilities, and diagnostics. With the addition of a removable 20MB hard disk, the $5,298 unit is hardly inexpensive compared with other contenders. One claim to fame at the lower base price is the paper-white 8.25- by 6.25-inch LCD—which is VGA compatible, thanks to a Gemini VGA LCD BIOS—in black and white with 256 shades of gray. Naturally, an external port is available for a full-size monitor.

In keeping with the LCD notion, the LT-386SX forgoes the cryptic mysteries

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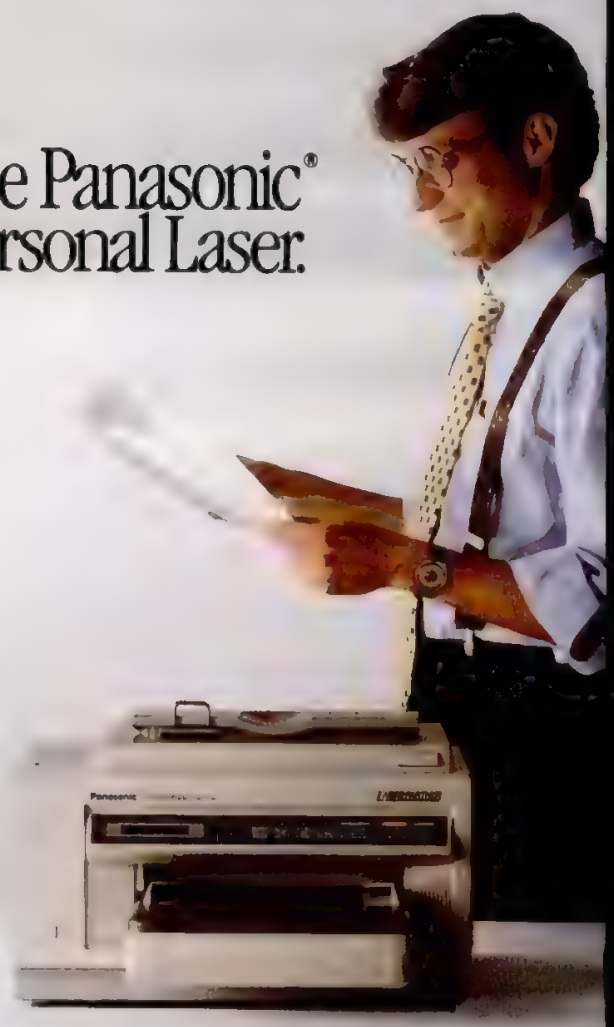

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Compatibility: HP LaserJet Series II emulation.*
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Paper Handling: 250-Sheet Cassette with Manual Feed. Face-up and face-down output.
Resolution: 300 Dots Per Inch.
RAM: 512K Standard, expandable to 4.5MB.
Interfaces: Centronics Parallel; Optional RS-232C Serial.

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LPF-PC

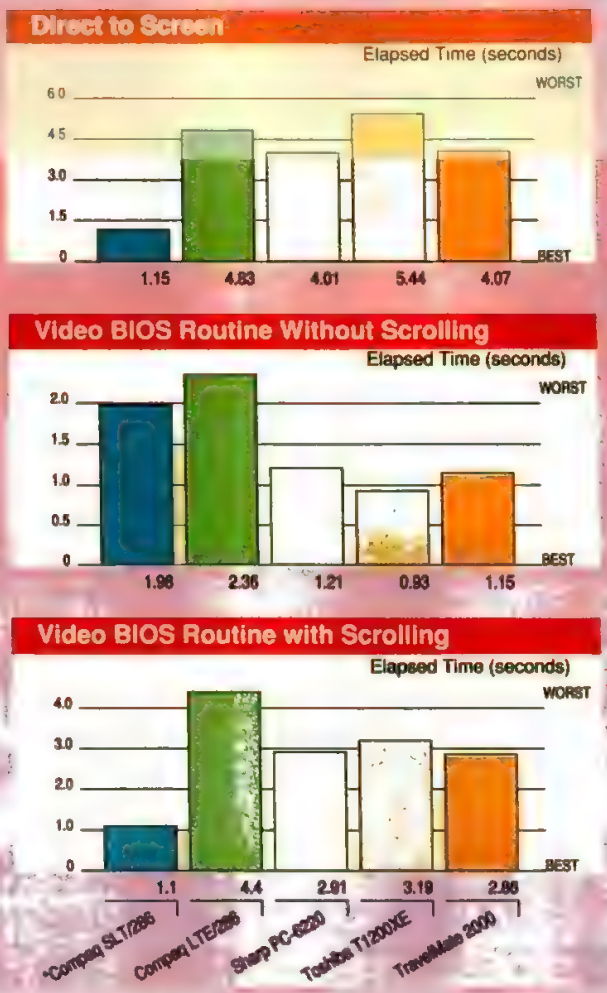
CIRCLE 122 ON READER SERVICE CARD

BENCHMARK TESTS: 286-BASED PORTABLES

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



of indicator lights in favor of a single-line LCD indicator of drive access or system status in icon format or plain English. It's located just above the keyboard.

The LT-386SX's case has some architectural features that bring to mind the intricate design of a Chinese puzzle box. You'll appreciate these details once you realize how easy it becomes to expand the portable's capabilities. Epson has thoughtfully provided external option connectors, recessed beneath small hatches in the sides of the machine.

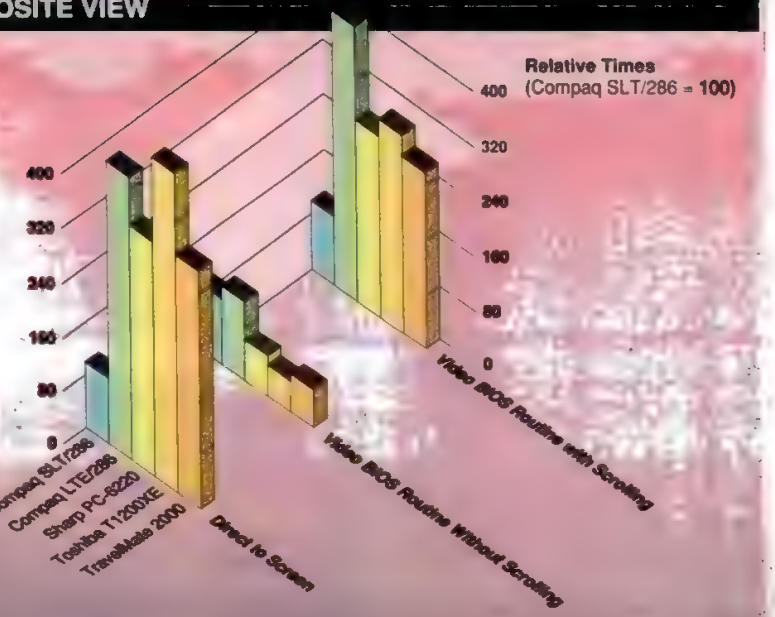
Ringing the perimeter of the laptop, for instance, is a series of lift-up doors that access the option connectors for a modem card ($299) and a memory upgrade. A 2MB option card retails at $799 and connects just as easily as the modem card. Lift the hatch, slide in the option, close the hatch, and the system realizes its 4MB capacity. Epson's crowning touch is a sliding panel underneath the LT-386SX that reveals a 16-bit ISA slot with room enough for a two-third-length card. Another trapdoor here makes any connectors on the rear of the card accessible once the panel is back in place.

Open the top to expose the keyboard and you'll notice a 1.5- by 4.25- by 6.25-inch space suitable for Epson's 20MB or 40MB removable hard disks, priced at $699 and $999, respectively. Just position the drive over the hole, lower it, press gently down, and it snaps into place. A small tab on the left side of the disk enclosure releases the drive. Thanks to an

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

Both the Compaq LTE/286 and the Toshiba T1200XE deliver performance that lags slightly on the Direct to Screen and Video BIOS Routine with Scrolling tests, reminding us that these two laptops use 8-bit video interfaces. Yet the Toshiba's CGA video does help it turn in a winning score on our Video BIOS Routine Without Scrolling test, where it clocks in with a time of 0.93 seconds.

The Sharp PC-6220 and the TravelMate 2000—for all practical purposes the same machine—both have solid performance scores on all three tests. They also offer great resolution (16 gray scales) and a display area of 8 by 6 inches.



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CIRCLE 347 ON READER SERVICE CARD

FACT FILE

Epson Equity LT-386SX
Epson America Inc., 2780 Lomita Blvd., Torrance, CA 90505; (800) 922-8911.
List Price: With 2MB RAM, VGA supertwist backlit LCD, 1.44MB 3.5-inch floppy disk drive, one parallel and one serial port, DOS 4.01, $4,599; with 20MB hard disk, $5,298; with 40MB hard disk, $5,598
In Short: "High-priced but versatile" defines the Equity LT-386SX. Its no-screwdriver approach to system expansion and its removable hard disks make it an attractive corporate purchase.

CIRCLE 546 ON READER SERVICE CARD

optional device called the DrivePort from Manzana MicroSystems, you can plug those drives into your desktop machine and access the data for consolidation.

External keyboard, video, parallel, and serial ports are located on the sides of the laptop, so there's no interference once the 4.1-pound battery pack is installed. Epson has eschewed the use of clamps and thumbscrews for the power pack by providing a slide-on positive locking system. An external power supply ($349) can be attached to the back of the nickel cadmium battery to recharge the computer during operation or overnight. Epson claims a 3-hour runtime after a 12-hour charge. Alternatively, the power supply can be used in place of the battery.

Your first look at the LT-386SX's keyboard is one of visual chaos. Epson provides full-size keys with standard spacing, but then attempts to provide full 101-key keyboard compatibility. Function keys grace the space immediately above the main keyboard, which is extended to the top and left to include separate cursor and line function commands. Instead of legends on a numeric keypad, there are overlays on several of the main keys. The best bet for word processing is to ignore the extras and just use the real keyboard section. The absolute simplicity and thorough versatility of the machine are strong advantages.

GRiD SYSTEMS CORP.

GRiD 1450sx

by Bruce Brown

GRiD Systems Corp. has always made attractive computers. The sharpest unit so far is the GRiD 1450sx, a sleek wedge-shaped laptop with a black magnesium case that's only 2.6 inches by 11.5 inches by 12.5 inches.

With the standard AC adapter, the system weighs 9.4 pounds. The $299 optional battery, rated at 2 hours, brings the system weight to 11 pounds, and the $399 4-hour battery tilts the scales at 12.4 pounds. For the power the 16-MHz 80386SX processor delivers, these weights are respectable. However, don't confuse this computer with a notebook-class machine; it's clearly a laptop and a very nice one.

The GRiD 1450sx is pricey at $7,483 for a 16-MHz SX portable, but its light weight may be worth the difference.

GRiD Systems, a division of Tandy Corp., only sells directly to the corporate market, which accounts for the relatively high-priced hardware.The minimum 1450sx system lists for $5,145 and comes stocked with 1MB RAM, a 20MB hard disk, one 1.44MB floppy disk drive, 640 by 480 VGA video circuitry, a supertwist backlit LCD screen, one parallel and two serial ports, and GRiD's custom version of DOS 3.3. PC Labs' test machine came with 3MB RAM, a 40MB hard disk, a 2,400-bps MNP Level 5 modem, a 2-hour battery, and EMM software at an eye-opening $8,159 list price—carrying case not included.

There's a shoulder strap, but you'll probably want to think twice about walking around with a computer this expensive hanging from your shoulder without the protection of a padded case.

GRiD manufactures its own motherboard and uses the Chips and Technologies 80386SX chip set and Phoenix ROM BIOS Plus. You can select either or both system and video ROM BIOS shadowing via setup software. The system maximum memory capacity is 5MB, using 2MB RAM upgrade modules, which sell for an expensive $1,090 each and utilize two each of GRiD's own 1MB 100-ns. DRAM chips. A slot on the motherboard accepts a standard 80387SX math coprocessor—a $506 option that can be purchased through GRiD.

There were no surprises in the PC Labs benchmark test results. The GRiD 1450sx is a 16-MHz 80386 machine with a standard 25-millisecond hard disk and 16-bit video. All test scores meet the expectations for that system profile. The PC Labs Battery Rundown tests, with all power conservation methods disabled, yielded unexpected results. The 2-hour battery kept the 1450sx going for 2 hours and 3 minutes, exceeding the specifications, especially since the screen and hard disk sleep modes weren't allowed. The 4-hour battery lasted only for 2 hours 44 minutes, however, so you don't gain much if you opt for the more expensive and heavier 4-hour unit. Battery conservation features include a system standby mode and screen and hard disk shutdown at user-selectable intervals of 1 minute to an hour.

Open the case and the bottom of the screen slides forward easel-style. The 10-inch-diagonal screen displays a 7.8- by 4.9-inch image with a reasonable 1.62 aspect ratio, for only slightly flattened

FACT FILE

GRiD 1450sx
GRiD Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94538-6559; (800) 222-4743, (415) 656-4700.
List Price: With 1MB RAM, 20MB hard disk, VGA supertwist backlit liquid crystal display, 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, DOS 3.3, $5,145; with 3MB RAM, 40MB hard disk, 2-hour battery pack, $7,483; with internal 2400-bps MNP modem, *386MSX EMM* 4.0, $8,159.
In Short: The GRiD 1450sx is an attractive 16-MHz 80386SX laptop with a choice of batteries—both heavy. The system's widely touted 7.9-pound weight doesn't include a battery or an AC adapter. If you downplay the weight factor, the 1450sx is a terrific portable machine, with a very good LCD screen and sleek design.

CIRCLE 547 ON READER SERVICE CARD

BENCHMARK TESTS: 386- AND 386SX-BASED PORTABLES

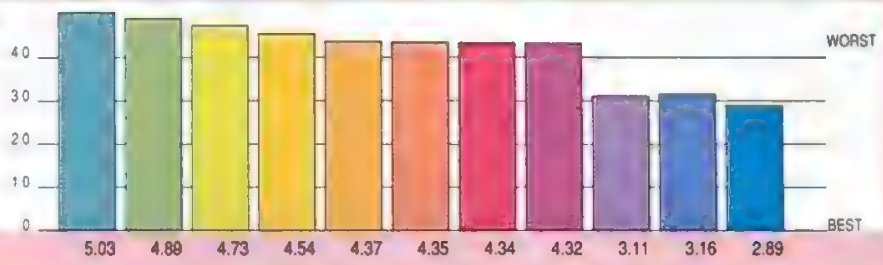
Among the ten machines we reviewed in this group, the 20-MHz 386SX-based Compaq SLT 386s/20 takes home the blue ribbon, besting the others on six out of nine tests. Yet the Best Performance for the Price award has to go to the Arima ACT 386SX-420.

PROCESSOR AND MEMORY BENCHMARK TESTS

80386 Instruction Mix

Elapsed Time (seconds)

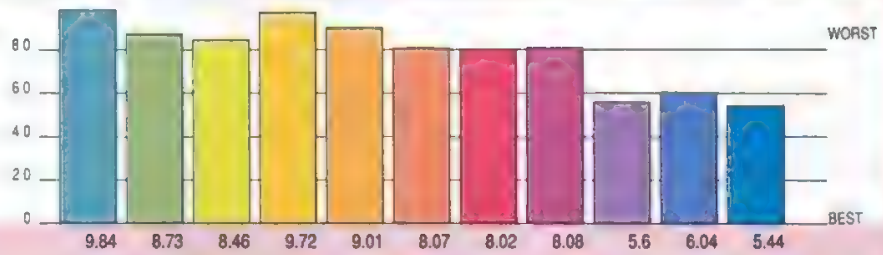
The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



Floating-Point Calculation Without Coprocessor

Elapsed Time (seconds)

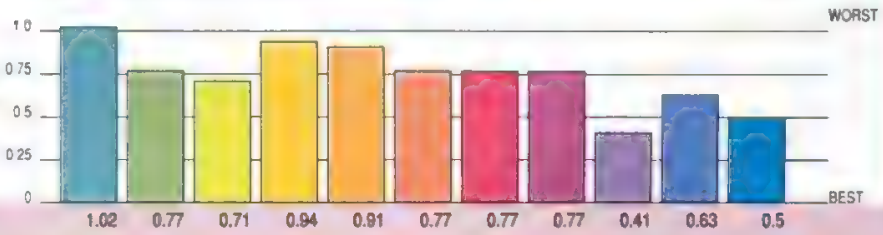
The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

Elapsed Time (seconds)

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

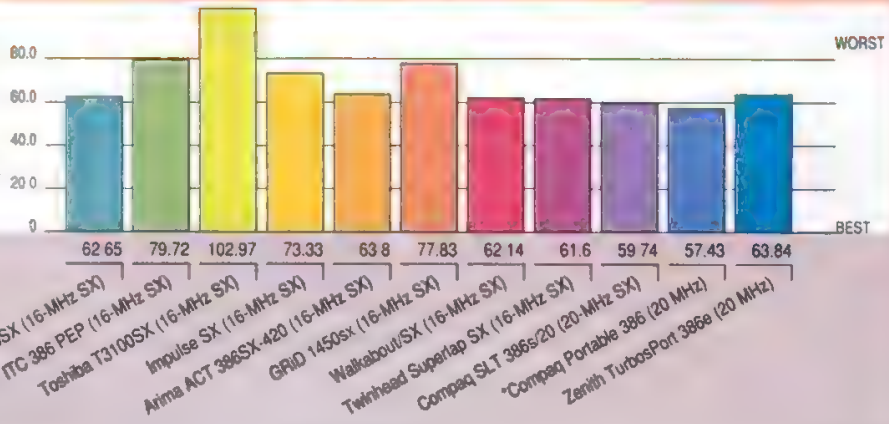


DISK BENCHMARK TESTS

DOS File Access (Small Records)

Elapsed Time (seconds)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



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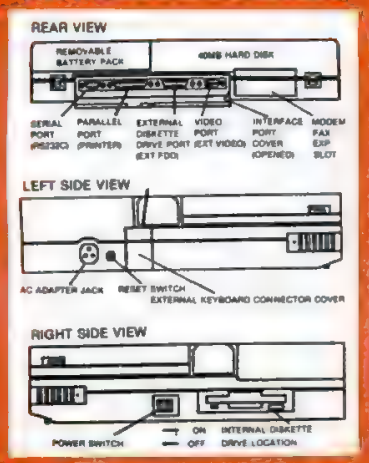

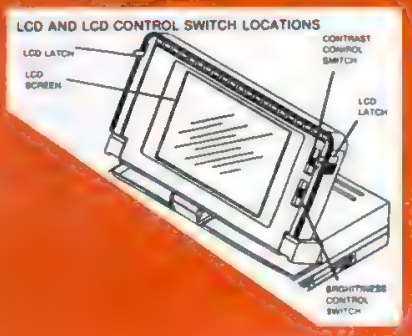

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CIRCLE 273 ON READER SERVICE CARD

BENCHMARK TESTS: 386- AND 386SX-BASED PORTABLES

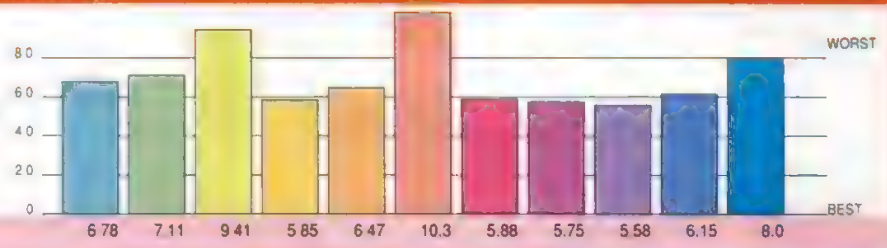
PC LABS

DISK BENCHMARK TESTS

DOS File Access (Large Records)

Elapsed Time (seconds)

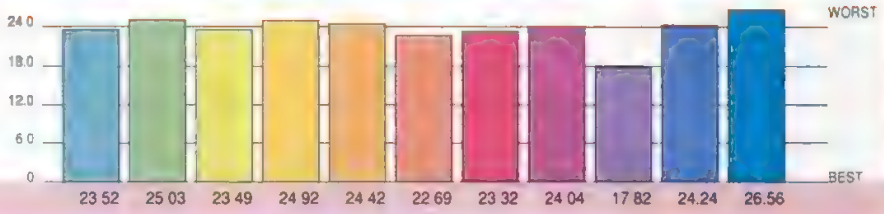
The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching.



BIOS Disk Seek

Elapsed Time (milliseconds)

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as data-bases, which often store and must later find data in many separate places on a drive.

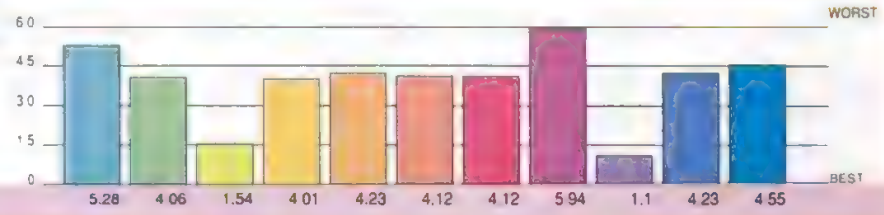


VIDEO BENCHMARK TESTS

Direct to Screen

Elapsed Time (seconds)

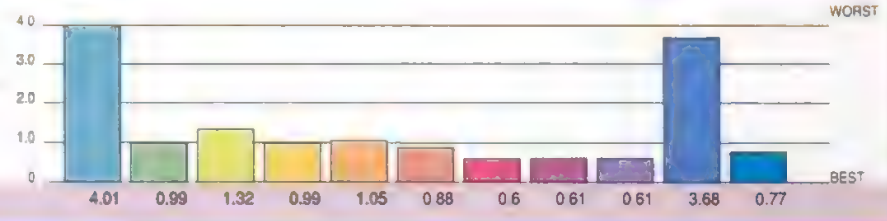
The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



Video BIOS Routine Without Scrolling

Elapsed Time (seconds)

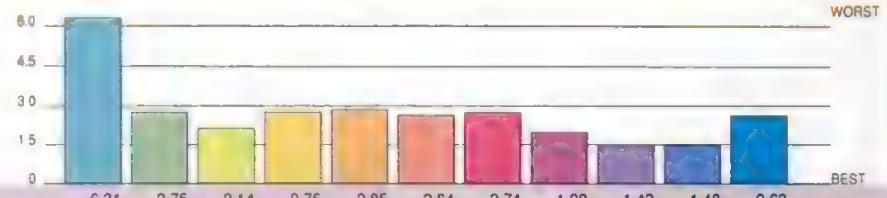
The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

Elapsed Time (seconds)

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



Epson Equity LT-386SX (16-MHz SX)
ITC 386 PEP (16-MHz SX)
Toshiba T3100SX (16-MHz SX)
Impulse SX (16-MHz SX)
Arma ACT 386SX-420 (16-MHz SX)
GRiD 1450sx (16-MHz SX)
Walkabout/SX (16-MHz SX)
Twinhead Superlap SX (16-MHz SX)
Compaq SLT 386s/20 (20-MHz SX)
*Compaq Portable 386 (20 MHz)
Zenith TurbosPort 386e (20 MHz)

* Reported for comparison.

CONTINUES

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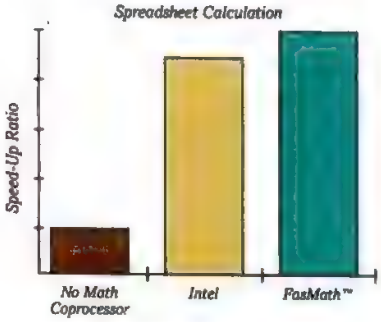
Cyrix FasMath math coprocessors provide real advantages for all 386® computer users.

SUPERIOR PERFORMANCE IS OUR MAIN ADVANTAGE.

Performance is why you buy a math coprocessor. And, the entire line of Cyrix FasMath processors were developed with superior performance in mind. Cyrix engineers have designed FasMath utilizing new technology. The result—FasMath processors are the fastest, most accurate and consume the least amount of energy when compared to all other math coprocessors on the market today.



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A math coprocessor offloads the complicated math functions from your computer's main processor, providing actual time savings. Depending on your application, FasMath can deliver up to three times the application performance of the Intel 80387. No other math coprocessor provides greater time-saving advantages than a Cyrix FasMath processor. In addition, FasMath computes results to 20 decimal digits of accuracy in the same time other coprocessors compute 7 digits. With FasMath, accuracy is never sacrificed for the sake of speed. Another FasMath advantage is that the FasMath processor runs cooler and uses less power than all other math coprocessors—a feature that is especially important to laptop users who can take advantage of extended battery life by using FasMath.

FasMath provides faster performance on many popular software programs.

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If you thought that only scientists, engineers and programmers performing high-level mathematical calculations could benefit from the performance advantages that FasMath delivers, think again. FasMath helps hundreds of leading software programs work faster. These include spreadsheets, databases, accounting packages, and of course scientific, engineering and graphics applications. FasMath is easy to install in any 80386 or 80386SX system, is fully compatible with IBM® PC based software and socket standards, and is backed by a 5-year limited warranty and toll-free support hotline.

An unprecedented combination of performance and value Cyrix FasMath is setting the standards for the 90's!

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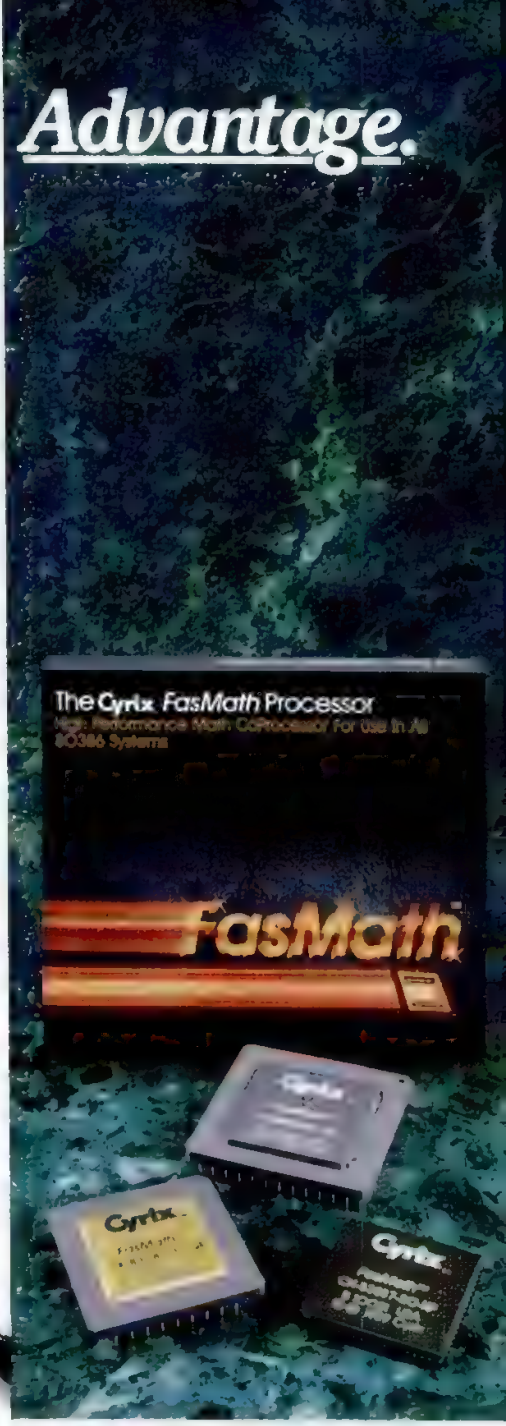
The entire line of Cyrix FasMath numerics processors offers the value-conscious buyer distinct advantages—faster performance, improved accuracy and low power dissipation, all at competitive prices. What's more, there are tens of thousands already in use today, attesting to the product's superior dependability.

So when it's time to choose a math coprocessor, get the one with *all the advantages*—FasMath by Cyrix. The world's most advanced numerics processors.



Cyrix manufactures a full-line of advanced processors for 386 systems at various clock speeds. For more information or where you can buy FasMath in the U.S.A. or Canada call **1-800-FASMATH** *(1-800-327-6284)*

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CIRCLE 747 ON READER SERVICE CARD

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circles in graphics screens. The display's backlighting is sufficient, but if you want better quality or color you can always plug an external VGA monitor into the 15-pin analog monitor port.

The GRiD 1450sx's 82-key keyboard includes an embedded numeric keypad and separate cursor control, page movement, and asterisk keys. The Ins and Del keys are located on the right side of the top row of keys, an unusual location but usable once you get used to it. For permanent locations, you can always plug a standard AT-style keyboard into the keyboard port.

The best way to use a GRiD 1450sx is to carry it without a power supply or battery. If you keep a power supply at all your regular working locations you can easily carry this sub-8-pound unit along with all the data you can load onto a 40MB hard disk, plus up to 5MB RAM and a usable VGA liquid crystal display. At your main location you can also keep an external monitor and keyboard for longer work periods. With a single 2-hour battery you'll be ready for occasional trips. The 1450sx isn't a notebook computer, but it's a fine 8-pound-plus battery-operated laptop system.

IMPULSE SYSTEMS INC.

Impulse SX

by Robert Kendall

The lightweight Impulse SX, from Impulse Systems, offers SIMM chip memory for an attractive $3,395.

Impulse Systems is a new arrival on the laptop scene. Its $3,395 Impulse SX is a solid 386SX with 2MB of RAM, a 40MB hard disk, 1.44MB floppy disk drive, and some attractive extras.

A clamshell unit weighing 14.4 pounds, this 386SX offers a couple of features usually reserved for larger portables. The easily removable keyboard comes attached to a 20-inch cord to accommodate the user's idiosyncrasies. Or just unplug the cord and you can substitute a standard AT keyboard. There's also a 16-bit half-length ISA slot behind a removable panel, another nice extra.

A second, proprietary slot will accept a 2,400-bps modem available, with or without limited fax capability. There's the full complement of I/O ports: one parallel, two serial, and a separate 25-pin connector for an external 5.25-inch floppy disk drive.

To complete the expansion options, the Impulse SX will accept conventional SIMMs to bring the total RAM up to 5MB. This makes for inexpensive memory upgrades—currently about $100 per megabyte.

The machine's backlit LCD screen supports VGA, has a clear font, and is legible at just the right angle. You can remap the display's 16 gray-scale levels to different colors. Unfortunately, though, response is slow, ghosting is a severe problem, and there's a noticeable flicker in some modes. You'll probably want to make use of the analog VGA port to hook up to a CRT display whenever you can—an option made more convenient by the removable keyboard.

The keyboard has a solid feel and full-size keys. The numeric keypad numbers overlaid on the letter keys are also easier to read than on many other keyboards. The layout is a bit cramped, though, mainly since everything has to fit on the removable tray. There are no separate PgUp, PgDn, Home, and End keys. Instead, these functions are inconveniently overlaid on the cursor keys, accessible only by the overlay toggle key. The 12 function keys aren't grouped into the usual three groups of four, making them harder to find as well.

Our tested configuration—which was upgraded with an additional 2MB of RAM from the 1MB, $3,295 base unit—was the slowest performer among the 386s on our processor and memory benchmark test suites. Its 40MB Conner IDE hard disk performed well, though, and a 100MB hard disk option is available from Impulse Systems for $800.

Two removable 1-pound batteries gave the Impulse a respectable time of nearly 2 hours on our Battery Rundown test. A Quadtel BIOS allows several battery-saving options: at user-selectable intervals, the system will disengage the display, turn off the hard disk, and shift the processor from 16 to 8 MHz whenever these components are not in use. An audible low-battery alarm would be nice, though, to complement the LED warning. Recharging time is about 2 hours with the computer off, and spare batteries are available as an option, listing for $129 each.

In addition to DOS and some utilities, the system comes with a personal information manager called *Arriba*. An EMS driver isn't necessary, since Impulse Systems has taken the step of building LIM 4.0 support into the hardware. You can configure different combinations of extended and expanded memory via the system setup menu.

There are a couple of complaints. After a long haul, the grooved carrying handle cuts uncomfortably into the hand. Also, the manual needs a lot of work. It lacks an index and is riddled with an unspeakable number of grammatical atrocities, which bring to mind an inept translation from another language. For example: "Replace back the adapter after a few minutes will cause the adapter to charge the battery no matter it is empty or not."

Nevertheless, if you can live with the LCD screen, the Impulse SX offers an appealing combination of relatively light weight, ISA expansion capability, and respectable battery life.

FACT FILE

Impulse SX
Impulse Systems Inc., 85 Burnett Ave., San Francisco, CA 94131; (415) 641-9197.
List Price: With 1MB RAM, a 40MB hard disk, a VGA supertwist backlit liquid crystal display, 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, DOS 4.01, *Arriba* (PIM), $3,295; with 2MB RAM, $3,395; with 3MB RAM, $3,495.
In Short: Though marred by a poor LCD screen, the Impulse SX offers attractive options such as a 16-bit ISA slot and inexpensive SIMM memory upgrades. It comes in a relatively lightweight clamshell package.

CIRCLE 548 ON READER SERVICE CARD

WE'D LIKE TO SHOW YOU THE BRAINS OF A TANDON COMPUTER.

These are some of the engineers at The Tandon Corporation. The brains. The people who design and engineer our computers from the ground up.

Between them they're responsible for more than two dozen patents. Quite a few of those coming from our chief architect, Dave Kummer. Dave was one of the original IBM PC architects. One of the original pioneers.

Nowadays, he and the rest of these folks are still very busy exploring, tinkering, customizing chips, looking for some way to push personal computing just a little bit further than it's gone before. Take our 486 for example.

They designed a Tandon exclusive, the PowerPoster™ a smart write buffer that intercepts write operations from the 486 and sends large amounts of data to RAM in a single burst.

To further speed internal communication they added a 64 bit wide memory bus (twice the width). And designed in EISA bus technology which allows up to a 33 megabytes per second transfer rate, instead of the usual 8. The result is one of the fastest computing times ever recorded. What

PC Computing called "the fastest computer in the world."

Of course there are also smart things about Tandon computers that our engineers didn't come up with.

We sell direct, so we can charge you a very reasonable price. We give you 24-hour tech support for life. And if for any reason you're not happy with your Tandon Computer, you can return it for a full refund within the first 30 days.

So pick up the phone and find out more about Tandon. It might make you feel pretty smart yourself.

Tandon Computers

Call 800 800-8850

Please turn page for price and product specifications.

Don't let the small footprint fool you. The SL 386sx packs Intel 80386™ power with full 32 bit internal processing, so it will run all of your existing applications faster. It just takes up less space on your desk.

A proprietary Tandon chip called MIAT (which stands for Mapper-Integrated AT) provides a higher level of systems integration. And because Tandon designs and engineers all of our own systems you'll find communications ports and mass storage controllers are all resident on the mainboard. With more than enough internal expandability to open the window to as much memory as you can buy.

We've put the awesome power of the Intel 80486™ into a slimline package, added a few technical advances of our own, and the result is the ultimate computing machine.

To start with, we used the Intel 80486™ chip with numeric coprocessor and 8k memory cache on a single chip. The cache provides faster memory reads and a co-processor handles even the most difficult calculations with the utmost speed.

With that done, we went to work on the write operations. We added a Tandon exclusive, the PowerPoster™, an intelligent buffer that speeds write information to RAM. It also eliminates the need for more expensive cache memory found on most of our competitors.

Add in Tandon's Memory Mapper providing Flex Shadowing of RAM for faster processor performance, the MIAT™ chip for greater integration, and you've got the fastest machine we could possibly fit into this attractive slim case. All at an even more attractive price.

STANDARD FEATURES

3.5-inch high-density, double-sided 1.44 MB diskette drive, or 5.25-inch 1.2 MB diskette drive.

Two-speed 8/16 MHz 80386SX processor (SL 386sx); Two-speed 8/25 MHz 80486 processor (SL 486); keyboard selectable clock speeds.

1 MB memory, diskette drive controller, video controller, IBM-compatible, parallel and two RS-232-C serial ports, math co-processor socket on main board. (SL386sx only)

Built-in single screen system setup utility automatically configures diskette drive, security and serial and parallel options; easy selection of security levels, external peripherals, and routine functions such as date, time, language, etc.

Built-in speaker with programmable, IBM-compatible sound.

Dimensions: 18.3 in. wide by 16 in. deep by 5 in. high. Weight 31 lbs. (SL 386sx); 32 lbs. (SL 486).

System unit, keyboard, power cord, operation and installation manual, Tandon MS-DOS software and manual.

HARDWARE HUMOR. An informed source has it, that at a recent trade show in Los Angeles, a group of EISA engineers were seen getting on the wrong bus.

Universal 101-key enhanced layout keyboard, low profile with 12 function keys; LED indicators for Num Lock, Caps Lock, and Scroll Lock Keys; password security.

Two 5-1/4 inch and one 3-1/2 inch drive bays.

Personal password protects data and software.

Three 16-bit AT-compatible expansion slots and one 8-bit XT™ compatible slot.

130-watt, fan-cooled power supply; switchable to 115 volts or 230 volts.

OPTIONS

Memory modules (to 5 MB total), Windows 3.0, 80387SX math co-processor (SL 386sx); 110 MB or 200 MB IDE fixed disk. VGA & super VGA color monitors, serial/bus mouse, 2400 baud modems, ethernet cards, laser printers.

Tandon SL 386sx $2,100.
Tandon SL 486 $4,399.

Both systems include 1 MB RAM, 40 MB IDE drive, VGA monochrome monitor, 16-bit video card.

Tandon Computers

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CIRCLE 284 ON READER SERVICE CARD

INTELLIGENCE TECHNOLOGY CORP.

ITC 386 PEP

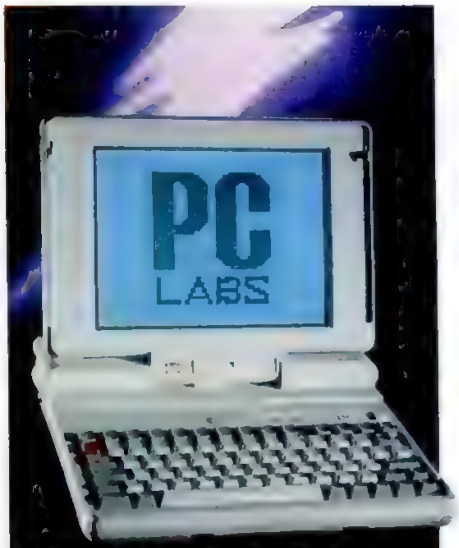
by Fredric Burke

Somewhere it is written that quirky designs must not work, because they force the user to make too many compromises. ITC's ITC 386 PEP (which costs $4,244 in our standard configuration) falls short for this very reason. Though basically a sound machine and a solid performer, it fails to go far enough to address the needs of the user. The result is a machine that would benefit from some rethinking on the part of ITC.

Fundamentally, the PEP has the basic tools to compete effectively in the crowded and competitive 386 laptop market. Our test unit ($4,342) included the standard configuration—a 386SX processor operating at 16 MHz, 2MB of 120-nanosecond RAM, a 40MB 28ns. hard disk, an external 3.5-inch floppy disk drive, one parallel and one serial port, DOS 3.3, and a 2,400-bps modem—as well as the optional battery charger and carrying case.

Without the external drive, charger, and case, the base price drops to $4,095. You'll need the external drive, however. ITC has chosen not to fit an internal floppy disk drive to the machine.

The PEP's modest 2.5- by 11.8- by 12-inch dimensions and 8-pound weight (including its 1.5-pound battery pack) make it easily transportable. Neither the weight nor the price will increase much, because of the dearth of options; these are limited to the external floppy disk drive, battery charger, and carrying case, and a 12-volt vehicle adapter. While extended memory is available, ITC offers neither



Intelligence Technology Corp's affordable ($4,244) ITC 386 PEP is a sturdy machine with a standard internal modem.

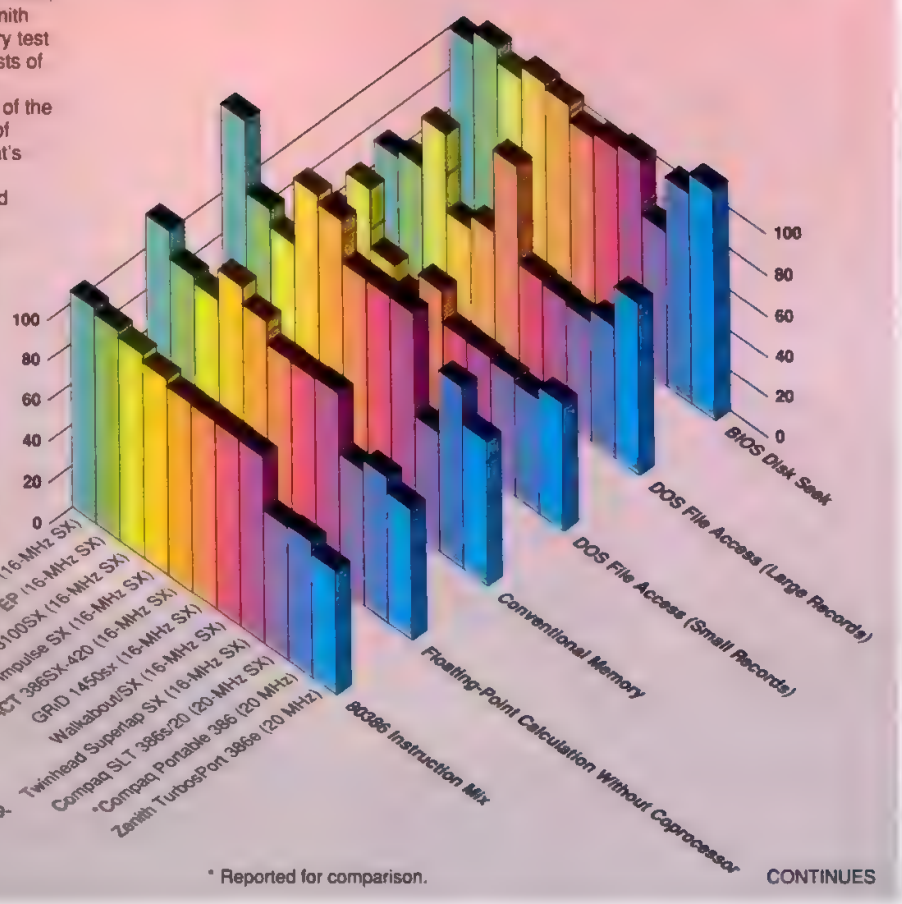
PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

There's no contest among the SX portables–and there's no substitute for megahertz, either. At 20 MHz, the SX-based Compaq SLT 386s/20 and the Zenith TurbosPort 386e produce processor and memory test scores that devour the competition, which consists of 16-MHz machines. The Compaq SLT 386s/20's performance on these tests reflects the benefits of the faster clock speed, with an able assist from 4K of associative processor RAM cache (a feature that's missing from the other entries).

While Compaq is tight-lipped about the brand names and performance specifications of the components that its computers use, the 120MB hard disk in the SLT 386s/20 suits the system well. Clocking at just under 18 milliseconds on our BIOS Disk Seek test, it's the fastest disk drive among the SX and full-fledged 386 portables. It emerges in the lead on all three of our disk benchmark tests.

Even without processor RAM cache, the Zenith TurbosPort 386e produces some good results. But in the light of its lackluster scores on the other benchmark tests, its strong processor and memory test performance is not significant enough to give it a viable edge over the Compaq SLT 386s/20.

While none of the 16-MHz SXs stand out as the best performer on our processor and memory tests, the Epson Equity LT-386SX does stand out as the worst, placing last in all three cases. The Twinhead Superlap SX, with a Conner 40MB hard disk, surpasses the other 16-MHz 386SXs on both DOS File Access tests, with a score of 61.6 seconds on the small-record test and 5.75 seconds on the large-record test.



* Reported for comparison.

CONTINUES

mass storage upgrades nor math coprocessor support.

Other models, the ITC 386 CEL ($6,000) and the ITC 386XCEL ($5,600), both offer 4MB of RAM, a 40MB hard disk, and internal floppy drive, and a cellular phone, and are thus more expensive.

Battery testing showed that the PEP lasted about 2 hours—sufficient, but certainly not up to the standards of the class. Battery life can be extended somewhat through the use of typical power-saving features—screen blanking and a user-definable disk shut-off, with the setup found in ROM. An LED warning 15 minutes before shutdown alerts the user that power is getting low. The user must move quickly because the machine will not retain memory when the battery level gets low. When that happens, it's best to head for the nearest outlet or turn the machine off and plug in another battery pack.

The PEP's screen provides more in the way of mixed messages. The fairly large back-lit VGA screen and its page-white mode provide good character formation. Graphics retain crispness and detail despite the minimal blooming and streaking. On the other hand, while the brightness and contrast controls provide ample adjustment for varying light levels, the unevenly lit screen is washed out in the lower left-hand corner and along the sides. Ghosting and an odd bluish-green tint to the screen in reverse mode further strain the eyes.

The keyboard is adequate but it has only 77 keys, which ITC accomplishes by eliminating two of the function keys and doubling up the PgUp, PgDn, Home, and End keys with the cursor keys. The result are keys almost as large as those on a standard keyboard. Unfortunately, though, they're saddled with cheap and rattling action uncharacteristic of the machine's relative solidity. The awkward arrangement of cursor keys detracts from the otherwise logical and convenient keyboard.

The ITC 386 PEP's best use is open to question. Battery life is fairly short for a machine equipped with this kind of processing power, and the screen and keyboard are only average. The daft exclusion of an internal floppy disk drive forces the user to rely instead on a bulky external drive that eats up a port. Apart from being a major inconvenience, it begs the question of whether or not the designers ever intended the machine to be used in transit.

FACT FILE

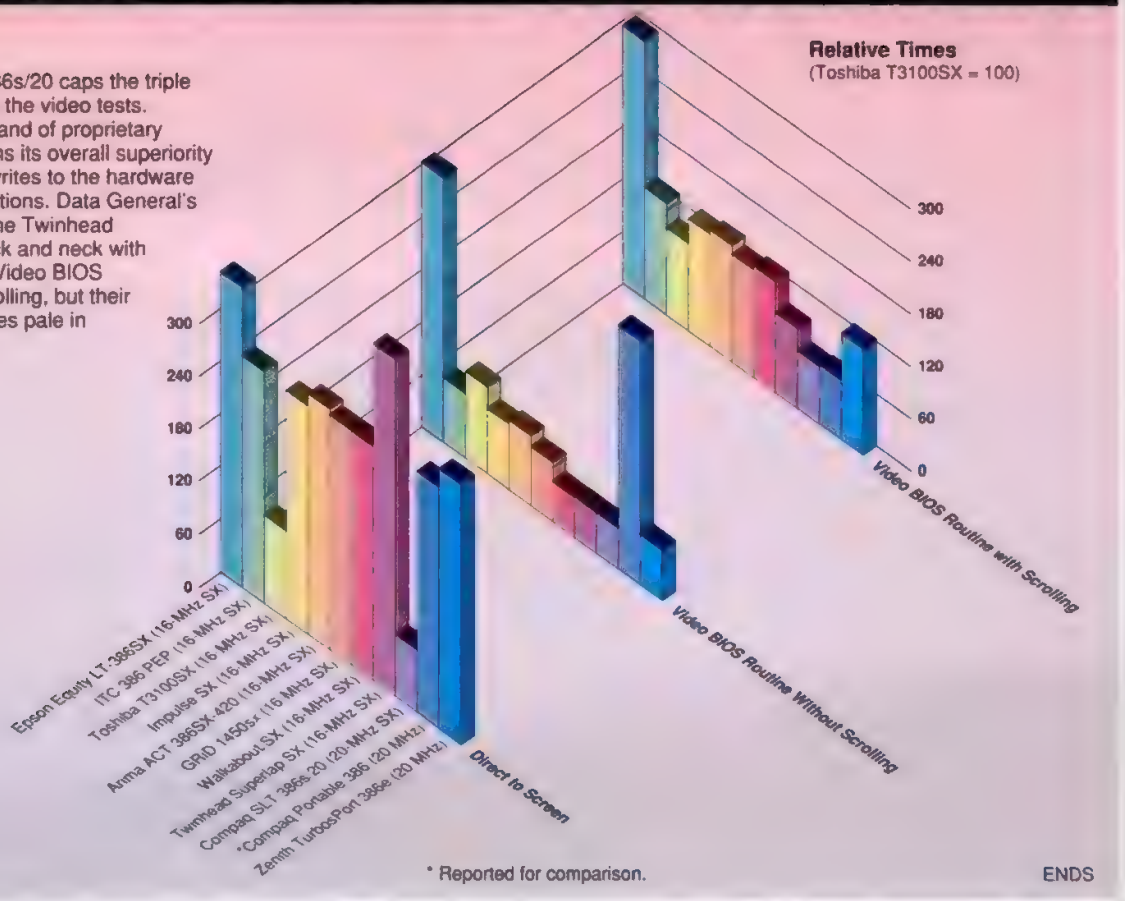
ITC 386 PEP
Intelligence Technology Corp., 16526 Westgrove Dr., Dallas, TX 75248; (800) 356-3493, (214) 250-4277.
List Price: With 2MB RAM, 40MB hard disk, VGA backlit LCD, one parallel and one serial port, DOS 3.3, 2,400-bps internal modem, $4,095; with external 1.44MB 3.5-inch floppy disk drive, $4,244; with external charger, carrying case, $4,342.
In Short: The ITC PEP is fundamentally a sound machine, nicely put together, but unevenly developed. The lack of an internal floppy disk drive limits its usefulness, as does its short battery life.

CIRCLE 549 ON READER SERVICE CARD

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

PC LABS

The Compaq SLT 386s/20 caps the triple crown by dominating the video tests. Compaq's special brand of proprietary video magic maintains its overall superiority through both video writes to the hardware and video BIOS functions. Data General's Walkabout/SX and the Twinhead Superlap SX run neck and neck with the Compaq on our Video BIOS Routine Without Scrolling, but their other video test scores pale in comparison.



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The new look of power.

286 processing in a computer that's notebook size, 1.4″ thin and 4.4 lbs. light.

Introducing the TI TravelMate™ 2000 notebook computer — from the company that pioneered portable computing solutions.

Since inventing the first portable data terminal in 1969, TI has led the way in packing more and more functionality into smaller and smaller products. Now TI brings you the next generation in portable computing — the TravelMate 2000.

This sleek, 4.4-lb. notebook computer gives you the power of a PC-AT® in an ultrathin 8½″ x 11″ package. It's designed to fit your workstyle — wherever you work — in the office, at home or on the road. Just slip it in your briefcase with your file folders, journals and other business materials, and you're ready to go.

Large VGA screen with leadership display technology.

You'll appreciate the technology behind the 10″ diagonal VGA display. It's a remarkable feature for a computer that's notebook size. The high-resolution 640 x 480 supertwist screen easily handles demanding windowing and graphics applications.

More features to meet your application needs.

The TM 2000 has the power to run your favorite software — 12 MHz 80C286 processor, 20MB hard disk drive and 1MB of RAM. A built-in, rechargeable battery lets you work up to two hours. With an optional add-on battery, you can work up to five hours — enough for coast-to-coast flights.

You also get a full-function AT enhanced keyboard, so you can work with the same feel of your desktop PC.

In addition, we've loaded MS-DOS® and LapLink™ in ROM, and preformatted the hard disk.

For more information call **1-800-527-3500.**

TEXAS INSTRUMENTS

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Eight Top Databa Out On dBAS

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President, Adam Green Seminars, Lexington, MA:

"It's significantly faster in some very important areas, especially in the fancy, attractive user interface... It's a very stable product, very reliable. I can safely recommend it."

PAT ADAMS
President, DB Unlimited, Brooklyn, NY:

"With standardization on the dBASE IV language, we have our database standard, which makes life easier for me, for my clients, and every other dBASE user... It's a solid, reliable product that performs the same way every time."

BOB DAVIES
President, SBT, Sausalito, CA:

"Memory utilization is much better than either dBASE III PLUS or dBASE IV version 1.0—a very substantial improvement. This means we are able to run our products, which require lots of memory and the need for a network, in a dBASE IV 1.1 environment."

SCOTT ROBERTSON
President, Champion Business Systems, Golden, CO:

"We think that it's solid. We think it's reliable. We think it's an excellent foundation for future development. The great thing about dBASE IV is that it has a flexible language and a good user interface. With dBASE IV version 1.1, end-users can take the product and tailor it so it fits their exact needs."

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se Experts Speak
E IV Version 1.1.

TONY LIMA
Author of "Inside dBASE IV," President, Pacific Systems Design Workshop Inc., San Carlos, CA:

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HOMER BRANCH
Programmer Analyst, Chevron CEPS, New Orleans, LA:

"I'm using version 1.1 to develop applications right now...It's much easier to use than either dBASE III PLUS or 1.0... Because of the Control Center, version 1.1 allows my users to do queries and get their reports without calling me."

RICHARD BRENNER
President, Westar Systems, Colorado Springs, CO:

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SAM GILL
President, DataWiz International, Foster City, CA:

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While the price isn't bad, expandability is limited. Users can adapt to quirky design but not at the expense of function. The PEP has a ways to go.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T3100SX

by Robert Kendall

There are a number of good reasons Toshiba is a dominant name in laptops. The T3100SX is one of them. It walked away with an Editor's Choice in our last portables blockbuster and still shines among the competition. Packing solid 386 performance, 3MB of RAM, a 40MB hard disk, and a broad range of expansion options into our $6,998 test package, it's about as easily portable as this much power can be. A reasonable weight of 14.6 pounds, a comfortable carrying handle, and an optional carrying case make this laptop a pleasant traveling companion.

Making only a few concessions to its size, the T3100SX holds its own compared with desktop machines. You get a built-in high-density 3.5-inch floppy disk drive and choice of a 40MB or 80MB hard disk. The $5,999 base-priced unit has 1MB of RAM, expandable to 13MB via 2MB or 4MB modules.

Despite its formidable hardware array, the T3100SX was outperformed by its 386SX competitors on many of the benchmark tests, particularly in disk speed. On the 80386 Instruction Mix test, an indicator of overall computer performance, the T3100SX was slightly though not significantly slower than most of the others. The unit was among the fastest on the Extended Memory test.

Most remarkable is the bright, clear VGA gas plasma display that's perfectly readable at any angle and hasn't a trace of ghosting. The T3100SX also led the pack on the video speed tests. And all of this exacts no greater toll on the battery life—tested at 2 hours 48 minutes—than the less remarkable display quality of LCD-equipped units.

The keyboard has the full-size keys and solid feel of a desktop unit. The space-saving layout changes are sensible, and everything is easy to find. You still get 12 function keys and separate keys for everything but the numeric keypad.

When you return from your travels, the

Toshiba's T3100SX, $6,998, is a top-notch laptop with an outstanding gas plasma display that still travels well.

FACT FILE
EDITOR'S CHOICE

Toshiba T3100SX
Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; (714) 583-3000
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel and two serial ports, DOS 4.01, *QEMM*, *PC-Kwik Power Pak*, *Microsoft Windows* 3.0, $5,999; with 3MB RAM, $6,998.
In Short: The T3100SX is a top-notch laptop that gets excellent mileage from its batteries despite its outstanding gas plasma display. It offers enough expansion options to satisfy all but the most specialized needs. For anyone who doesn't want to compromise on the road, this machine is worth the premium price.

CIRCLE 550 ON READER SERVICE CARD

PERFORMANCE TESTS: PORTABLE PCs

On our Battery Rundown tests, very few portables exceeded the manufacturers' claimed battery life. The Compaq LTE/286, with its 14.8-volt nickel cadmium battery, not only won the contest for the longest battery life, it also exceeded the advertised spec of 3 and a half hours. The GRiD 1450sx also performed slightly better than expected, with a time of 2 hours and 4 minutes versus the 2 hours claimed by GRiD.

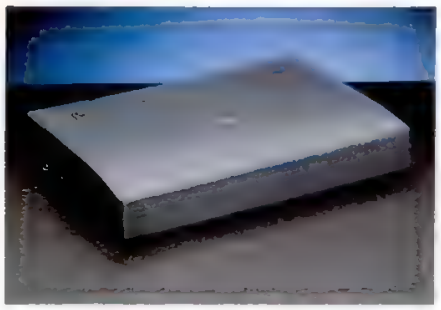
But the clear winner in exceeding expectations was the Toshiba T1200XE, which kept running roughly 18 minutes over the 2 hours predicted by Toshiba. The unit utilized a 12-volt nickel cadmium battery to accomplish this feat.

On the other end of the spectrum is the ITC 386 PEP, which delivered only half of the 2-hour battery life claimed by ITC. The Arima ACT 386SX-420 also disappointed us; although its performance was better than the ITC, it still clocked in at 45 minutes less than its promised 2 hours and 30 minutes.

The Battery Rundown performance test involves teletyping five screens of text to the laptop computer's display and writing a 15K file to the hard disk, once every minute until the battery runs out of power. All power conservation techniques are disabled.

* Reported for comparison.

Another page in printer history.



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On a desk, with its optional 30-sheet paper feeder, it's an ideal personal printer. As a single-sheet portable with its optional rechargeable battery pack, it weighs a remarkable 4.6 pounds and prints on a variety of paper. Moreover, the BJ-10e emulates the IBM® Proprinter™ X24E, so you can use a wide range of applications software.

How fast is it? It prints 83 characters per second and won't slow down when printing in bold or various type sizes. It even handles complicated graphics such as the scanned-in image printed here. And, it's so quiet it can be used in the middle of the night with someone asleep just a few feet away.

Plus you never have to worry about maintenance because it uses an economical pop-in BJ cartridge, containing the print head and ink supply, which prints approximately 700,000 characters (HQ mode). But best of all, the BJ-10e works everywhere you could possibly need it, fitting neatly into a briefcase.

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CIRCLE 155 ON READER SERVICE CARD

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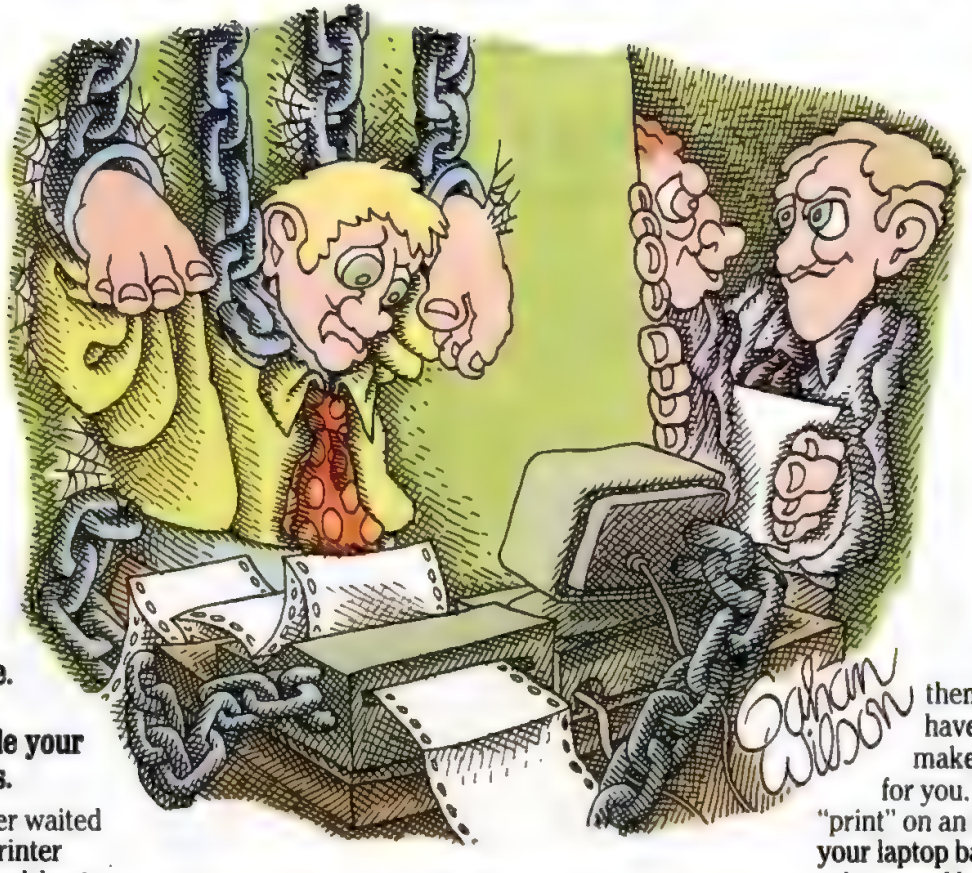

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CIRCLE 323 ON READER SERVICE CARD

T3100SX lets you take advantage of all the comforts of home. An analog VGA port lets you plug in a CRT monitor and run the plasma display simultaneously. As options, you can get an external numeric keypad or an adapter that lets you plug in your 101-key keyboard. An external 5.25-inch floppy disk drive can also connect to the parallel port. The laptop can even directly access the floppy disk drive of your desktop computer by plugging into an optional expansion card that fits into the desktop PC.

Chances are that you won't notice the T3100SX's lack of ISA expansion slots. If you just can't give up your add-on boards, there's an optional expansion chassis ($1,499) Toshiba calls a Deskstation. Equipped with more connectivity features than the previous five-slot docking station, the Deskstation has three slots—two 16-bit and one 8-bit, a 101-key keyboard connector, one parallel port, two serial ports, and a modem connection. Since there is no external monitor connector, you still have to connect your video to the back of the unit.

The laptop's parallel port and two serial ports are built-in, and there's a dedicated, internal connector for an optional 2,400-bps modem. The single proprietary slot can hold a Toshiba Ethernet LAN card, a modem card, or a variety of cards from third-party vendors.

Much of the T3100SX's success stems from Toshiba's understanding that a good laptop is more than just a desktop machine stuffed into a small package. The unit conserves battery power admirably and can stretch the 3-hour battery life further by automatically turning off the display, the hard disk, and even the CPU when these are idle. This keeps the user safe from low-power hazards. All RAM is nonvolatile, so you can turn the machine off and return to a program where you left it when you power up again; this eliminates any reason to leave the machine idling for long periods.

LEDs in different colors indicate the current state of the two removable batteries, and a pop-up on-screen graph shows the charge remaining in each battery. An audible alarm warns of low battery power and alerts you if you close the lid with the power on. If the batteries run down while you're working, a backup battery will preserve your work in nonvolatile RAM for about 8 hours after the machine automatically shuts off. AutoResume will take you back to where you left off. It takes only 3 hours to charge the batteries with the machine off.

If all this isn't enough to win you over, you get *PC-Kwik Power Pak*, *QEMM*, and, for a limited time, *Microsoft Windows* 3.0 thrown into the deal. This much power and convenience comes at a price. But if you don't want to compromise on the road, you'll find the Toshiba T3100SX worth the money.

TWINHEAD CORP.

Twinhead Superlap SX

by Salvatore P. Ricciardi

Based on the numbers, Twinhead's Superlap SX, with its 16-MHz 80386SX processor, 40MB hard disk, and VGA display may seem attractively priced at $4,095. Unfortunately, the machine you'll get after putting down your money suffers from design quirks that will make you question whether you really got a bargain.

The 12-pound Superlap SX comes packaged in a 3.5 by 12.75 by 9.5 inch case reminiscent of Compaq's SLT/286. It's equipped with 2MB of interleaved page-mode 80-nanosecond DRAM, expandable to 4MB. The Twinhead proprietary motherboard accepts four SIMMs and ships with 256K modules, so you'll have to replace these with 1MB SIMMs to upgrade to the full complement. The Superlap's upper deck panel pulls out to reveal easy access to both the SIMM locations and a socket for an 80387SX coprocessor.

The standard configuration also includes a 40MB Conner hard disk with an access time of 25 milliseconds, a single 1.44MB floppy disk drive, one parallel port, two 9-pin serial ports, an external floppy disk drive connector, and an expansion slot connector. A separate 15-pin female connector drives an external VGA monitor. The package also includes DOS 4.01, a carrying case, and a copy of the *PC-Kwik Power Pak* utilities.

An external keyboard connector resides on the right side of the unit. The keyboard sits on top of the unit but can be moved onto your lap or anywhere else within reach of the 3-foot coiled cable. The ability to detach it is the keyboard's only good feature. The feel is flimsy, and you have to hit the keys unusually hard to make things register. Key placement, too, is maddening. While Twinhead was smart to include dedicated cursor keys, it has the placement all wrong. Home is below PgDn; Ins and Del are on the function key row; and the Break key is on the bottom left, next to Ctrl.

The Superlap SX, aggressively priced at $4,095 from Twinhead Corp., is the company's first foray into the portable arena.

Watch out for another design pitfall: the Twinhead's sensitive power-on switch, a soft push button on the right side of the unit that obeys commands with total dedication, even when the unit is shut. The slightest bump to the unit can push the button, and the ensuing battery drain will enable the continuous battery alarm. Both you and your blue case will become conspicuously apparent when the alarm sounds off. Some advice: be sure the battery is charged before you pack the ma-

FACT FILE

Twinhead Superlap SX
Twinhead Corp., 1537 Centre Pointe Dr., Milpitas, CA 95035; (800) 545-8946, (408) 945-0808.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA paper-white side-lit liquid crystal display, one parallel and two serial ports, DOS 4.01, *PC-Kwik Power Pak* utilities, $3,995; with 2MB RAM, $4,095.
In Short: The Superlap SX suffers from a terrible keyboard and a near total lack of battery conservation features. If you can live with its keyboard and close to AC power, it's priced competitively. A newer model, due soon, promises improvements.

CIRCLE 601 ON READER SERVICE CARD

chine up for travel.

The Superlap's cold-cathode, paper-white sidelit VGA-compatible liquid crystal display boasts exceptional text clarity when properly configured with the supplied utility software. Driven by a Cirrus Logic VGA chip set, it's capable of displaying graphics in 640- by 480-dpi VGA resolution using up to 32 shades of gray. In addition, the VGA circuitry is capable of driving an external analog multisynchronous monitor at 800 by 600 Super VGA resolution. The overall display quality of the LCD was good, though you'll find yourself frequently adjusting the Superlap's sliding bar brightness and contrast controls depending on the application.

The 2-pound nickel cadmium battery, included in the unit's advertised 12.2-pound weight, is in the front of the unit below the keyboard. In PC Lab's benchmark tests, a fully charged battery lasted for approximately 1 hour and 25 minutes. Since the Superlap lacks battery conservation techniques, you'll need to keep this figure in mind when planning excursions away from an AC power outlet.

Overall, the Superlap SX is a great idea in need of fine-tuning. According to Twinhead, a new version of the Superlap SX is being developed. This Superlap SX may leave you with the sense of a job not yet finished. When it is, it'll be worthy of your consideration.

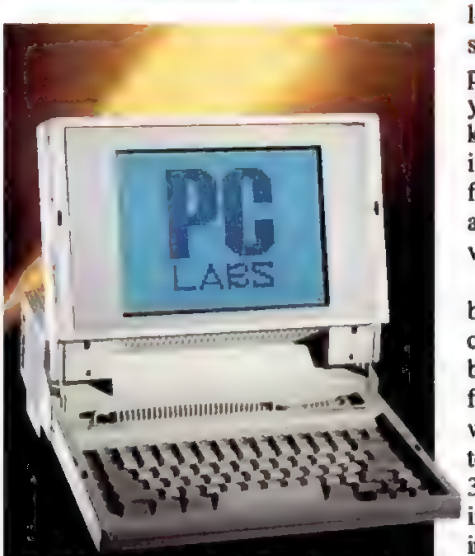
ZENITH DATA SYSTEMS

Zenith TurbosPort 386e

by Bill O'Brien

At over 17 pounds, the Zenith TurbosPort 386e is hardly a lightweight tagalong. Still, this $7,499 portable offers real 32-bit computing power at a higher processing speed than some desktops.

The 386e designation indicates that this TurbosPort is a real 80386—not an SX—running at 20 MHz. (The keyboard can also run at 10 MHz if your software requires a compatible speed.) The standard configuration includes 2MB of70 nanosecond DRAM memory running at zero wait states, a 40 MB hard disk, one 1.44MB 3.5-inch floppy disk drive (the case design prohibits any other internally mounted floppies), DOS, and utilities.



The $7,499 TurbosPort 386e is a real 20MHz 80386 computer in a quality portable case.

In keeping with the performance incentive, the IDE hard disk contains an 8K buffer that should give it a slight edge over similar-size devices. While there is no processor RAM cache, there is full-time video and system BIOS shadowing to boost these low-level machine operations. You can expand the system RAM to either 3MB or 6MB. Those specifications make *Windows* and even OS/2 realities for the TurbosPort.

Bus speed is rated at 8 MHz, and if there is a bus speed, there must also be a bus. Two I/O ports can be found inside the TurbosPort. One is proprietary and used solely for the 32-bit memory expansion, while the other, an 8-bit port, supports the optional Zenith modem card. The bus lines are carried out to a rear connector, and three additional slots can be added to the system using the TurbosPort's optional docking station.

A paper-white supertwist LCD screen handles the VGA video chores. Brightness and contrast controls along the backlit screen's right side permit sufficient adjustment to produce readable text at all but the most extreme angles. Naturally, Zenith has brought the VGA signals out to a rear connector in case you care to add a color monitor to the system.

In fact, the case design and weight seem suited to site transportation. The TurbosPort's keyboard is detachable—hardly something you'd need in a laptop. With the keyboard detached, the machine's entire weight is concentrated at the rear of the remaining enclosure. A small forward ledge at the base maintains the unit's stability. It's not easily tipped in that form, providing it's on a flat surface and not on your legs. Should you find the 79-key keyboard (with full 101/102 compatibility, thanks to key cap masks and a special function key) less to your liking, you can attach a full-size keyboard with the provided connector.

A 24-volt, 2.1 Amp/hour rechargeable battery pack powers the TurbosPort. It consists of ten C-size nickel cadmium batteries covered in shrink wrapping and fitted with a suitable connector to mate with the power plug in the recessed battery compartment. Zenith claims a 2.5- to 3.5-hour battery life and also offers built-in power-saving features—screen blanking and disk power-down at user-selectable intervals—to assist in endurance.

More important is the charger/power supply provided with the TurbosPort, which powers the portable with or without a battery and will truckle charge the battery pack (over 12 to 14 hours) while you're running the TurbosPort. You can turn off the portable, leave the power supply connected, and return in 2 hours to a fully charged system. Fast charging is an acceptable method of handling drained batteries but the high amperage used to fast-charge them will shorten their life from the typically rated 1,000 recharges. The trade-off of a few hundred recharges in return for fast system recovery is well worthwhile, however.

While definitely not the ideal laptop machine, the TurbosPort is one of the better compromises in desktop/portable computing now available. If your budget can't accommodate both show and go computers, the TurbosPort's optional docking station and solid 32-bit design make it an ideal compromise. ■

FACT FILE

ZenithTurbosPort 386e
Zenith Data Systems, 1000 Milwaukee Ave., Glenview, IL 60025; (800) 553-0331.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA page-white liquid crystal display, one parallel and one serial port, DOS 4.01, 2,400-bps modem, $7,499; with 3MB RAM, $7,998.
In Short: The Zenith TurbosPort 386e is a real 20-MHz 80386 computer that offers a good compromise between portable and desktop computing.

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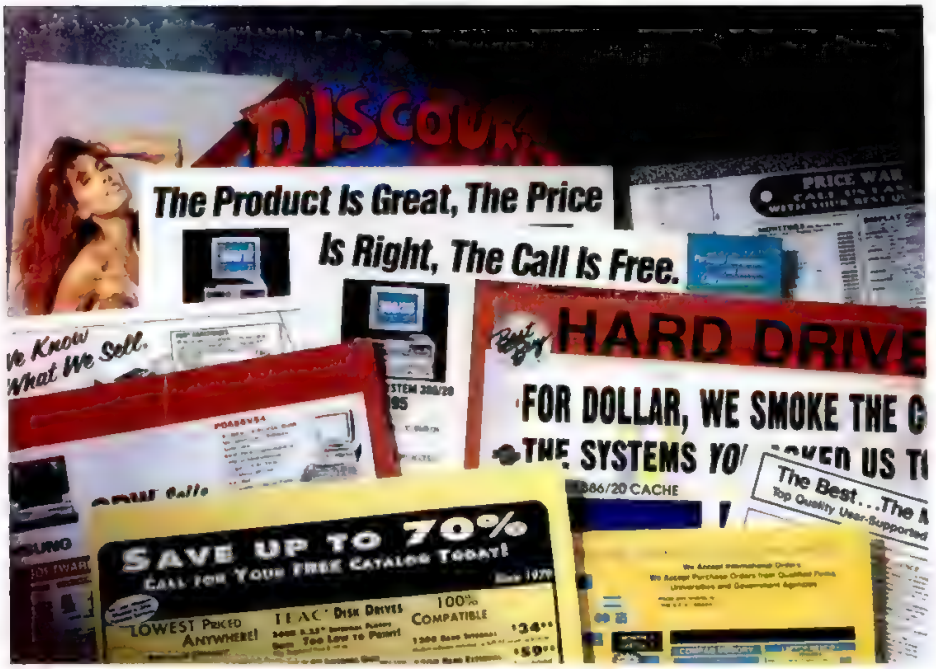

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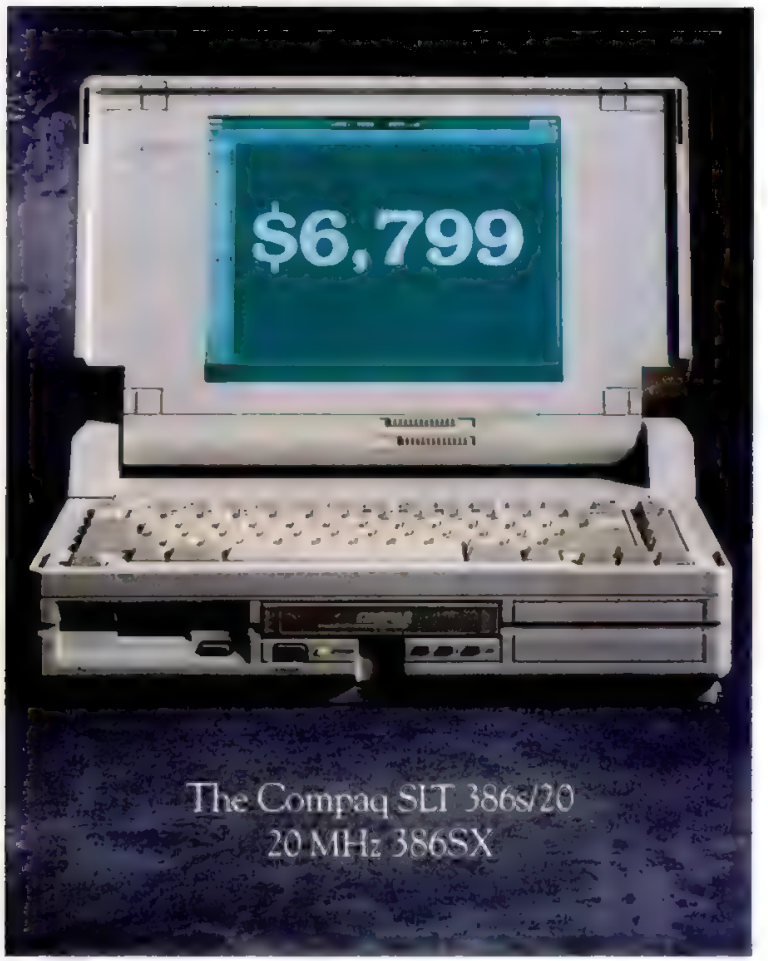

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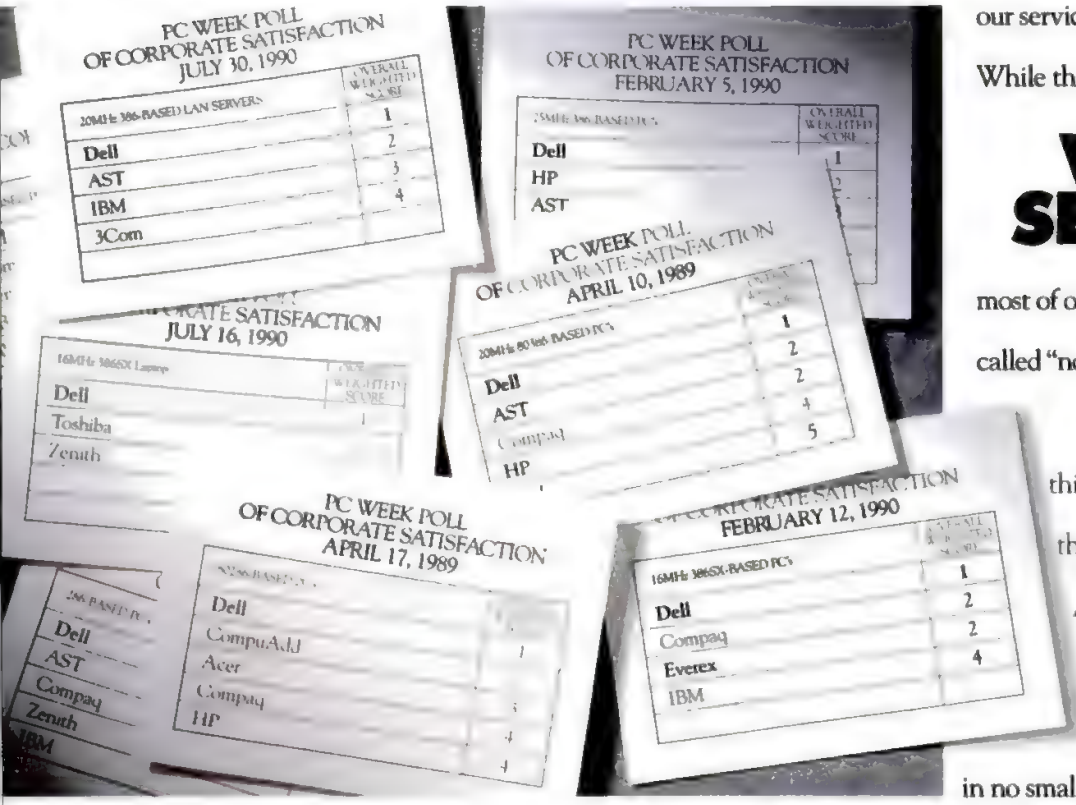

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Making DOS Work Overtime

386 MULTITASKING ENVIRONMENTS:

These five environments help you use your 386 to get the kind of multitasking capabilities that users of OS/2 and Unix enjoy, and the best part is you can do it without abandoning DOS.

by Brian Carr

Everyone seems to be talking about multitasking operating environments, but if you haven't used one of these systems, you may wonder what the commotion is all about. The answer is the dramatic productivity increase that multitasking can provide.

If you are like most people, you get sidetracked from a task to handle someone's request for information. With DOS, your PC can actually be an impediment when dealing with these interruptions, since you have to spend time gracefully exiting your present application and entering a new

PHOTOGRAPH: CARL FLATOW

one in order to answer the question.

In this evaluation, we focus on multitasking DOS environments that allow you to run several DOS applications simultaneously. They allow you to switch from one DOS application to another in a fraction of second. They even let you continue using your PC to compose a memo or look up a phone number while the PC performs a lengthy request such as a spreadsheet recalculation or bulletin board download in the background and out of sight.

The time savings may seem insignificant, but the increase in productivity is impressive. DOS users will become fans of multitasking DOS environments when they see how the PC can assist their thinking process rather than delay it.

REVIEW CRITERIA

In this article we review environments that extend DOS to run multiple DOS applications on 386 machines. Since last year's evaluation ("Multitasking Environments: When One PC Equals Four," February 28, 1989) we've excluded multiuser systems such as Digital Research's *Concurrent DOS 386* and The Software Link's *PC-MOS/386* since their forte is multiuser manipulation. Multitasking is just a small part of their story, and the overhead required to support multiple users would make the comparison unfair. We've also excluded full-fledged operating systems that don't involve DOS, like Unix and OS/2. Five environments are evaluated here: *DESQview 386*, *Microsoft Windows* 3.0, *Omniview 386*, *VM/386 MultiTasker*, and *Vmos/3*. If your PC is not 386-based, there's no need to feel left out. Most of these environments will run on other PCs, but with far less functionality.

DESQview 386 and *Omniview 386* each have versions that run quite reasonably on XT- or AT-class machines. They provide most of the functionality described here, with some restrictions on what applications can run in the background (not visible on the screen). Also, memory constraints will greatly restrict your ability to multitask if you don't have a 386 or significant expanded memory (memory above the first 256K should be bank selectable via EMS LIM 4.0 or EEMS).

Windows 3.0 will theoretically run on an XT-class machine, but performance will probably be less than acceptable. In *Windows*, you have the ability to run multiple DOS applications only if you have a 386 machine.

THE TROUBLE WITH DOS

DOS restricts applications to the so-called low memory of 640K. This limits the functionality of each application since it has to fit all of its code and data into that 640K. Multitasking DOS environments utilize many megabytes of extended memory so you can have multiple applications, but they are each limited in function by the 640K of memory. Expanded memory, DOS extenders, VCPI, and DPMI (see the sidebar "DOS Extenders to the Rescue") are already resolving this problem as they change the limits on DOS applications by making up to 16MB of high memory (above 640K) addressable. OS/2 and new *Windows*-specific applications do not have this limitation.

A more serious problem is the single-tasking nature of DOS itself. The DOS file system is a critical part of all these multitasking DOS environments and has no awareness of other tasks. This makes it difficult to know when DOS has started a disk I/O and when it is okay to have the CPU work on another problem. Only *VM/386* has worked out a good solution and it is more complex than if DOS were designed for multitasking.

DOS's single-tasking nature also requires the serialization (or queuing) of requests to DOS so that DOS will only be working on one request at a time. Not only does this require system overhead, it exposes the system to crashes. DOS applications intrinisically have direct access to DOS (DOS resides in their address space) and most of the reliability problems of these environments can be attributed to this accessibility and the difficulty of serializing in such an open environment.

SLICES OF TIME

In order to run multiple DOS applications simultaneously, a multitasking environment simulates having several PCs on hand by giving the CPU to each active task for a brief period and then moving on to the next task. This brief period is called a time slice. The system uses timer interrupts to initiate the switch between applications.

The manner in which the system allocates the CPU to the different applications is of great personal interest to each user, and there is no one correct way. PC Labs' benchmark test results show the default division between the foreground task (the application visible on the screen) and the background tasks. Within each review we discuss the degree to which you can configure this division to your own preferences.

MORE WAYS TO JUGGLE TASKS

There are many ways to move from one application to another in DOS without using a 386 multitasking environment like the ones evaluated here.

The simplest way is to learn how to use

EDITOR'S CHOICE

- **DESQview 386**
- **VM/386 MultiTasker**

VM/386 MultiTasker, a previous Editor's Choice, is still the strongest multitasker for power users who want to tailor their system to precise specifications in order to run several applications simultaneously. Compatible with more hardware and with a published API, *VM/386* is more stable and complete than *Vmos/3*, which is similar to *VM/386*. You'll want to proceed with caution, however. *VM/386* is still fairly difficult to use.

You should consider *DESQview 386* and *OmniView 386* if you don't do much work with graphics and just want straight DOS-application multitasking. *DESQview 386* offers more features such as text windowing, cut-and-paste capabilities, and keyboard macros. If you don't need all that, turn to *OmniView 386*, which earns an honorable mention for its low cost, speed, and ease of use.

You should consider *Windows* 3.0 if you do a lot of graphics work, want to start using the highly touted graphical user interface, or if your applications are intended to run under *Microsoft Windows*. As a multitasking operating system, *Windows* has adequate performance, but its user interface is the most polished of the environments we evaluated. In other words, you can do better than *Windows* if your goal is simply to multitask. What makes *Windows* 3.0 so good is its interface, not its multitasking.

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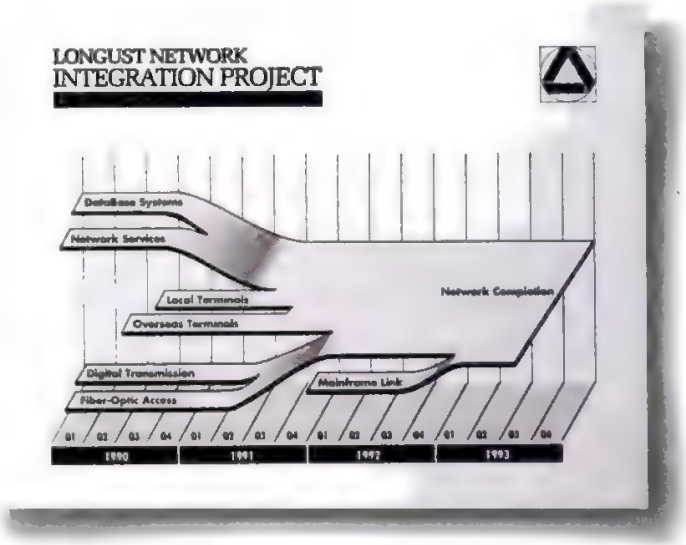

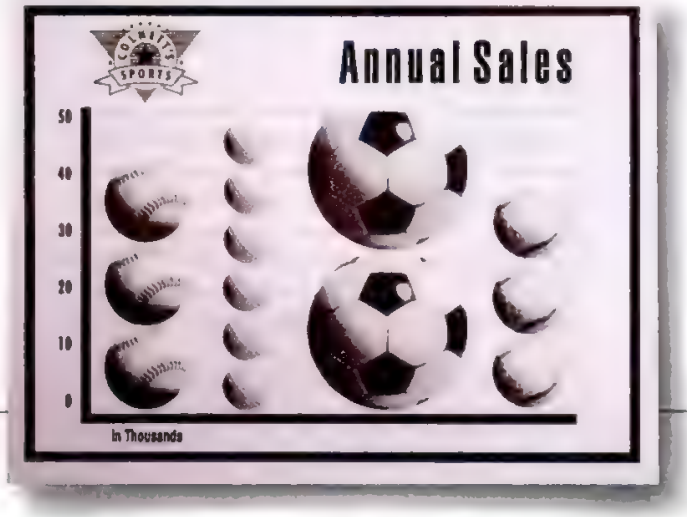

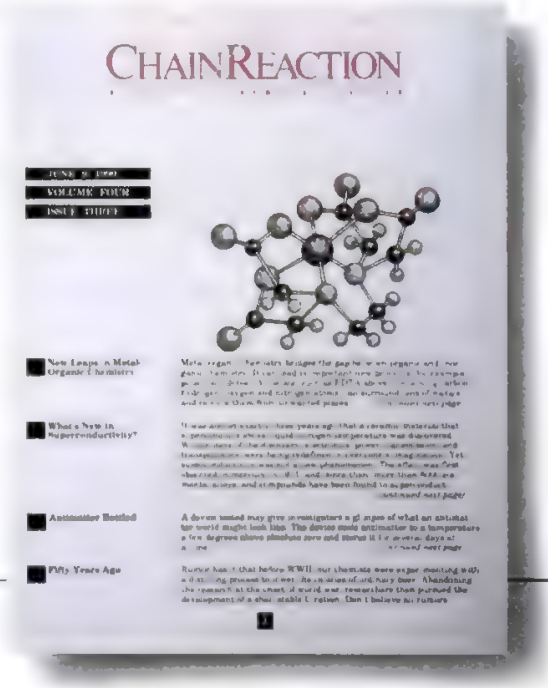

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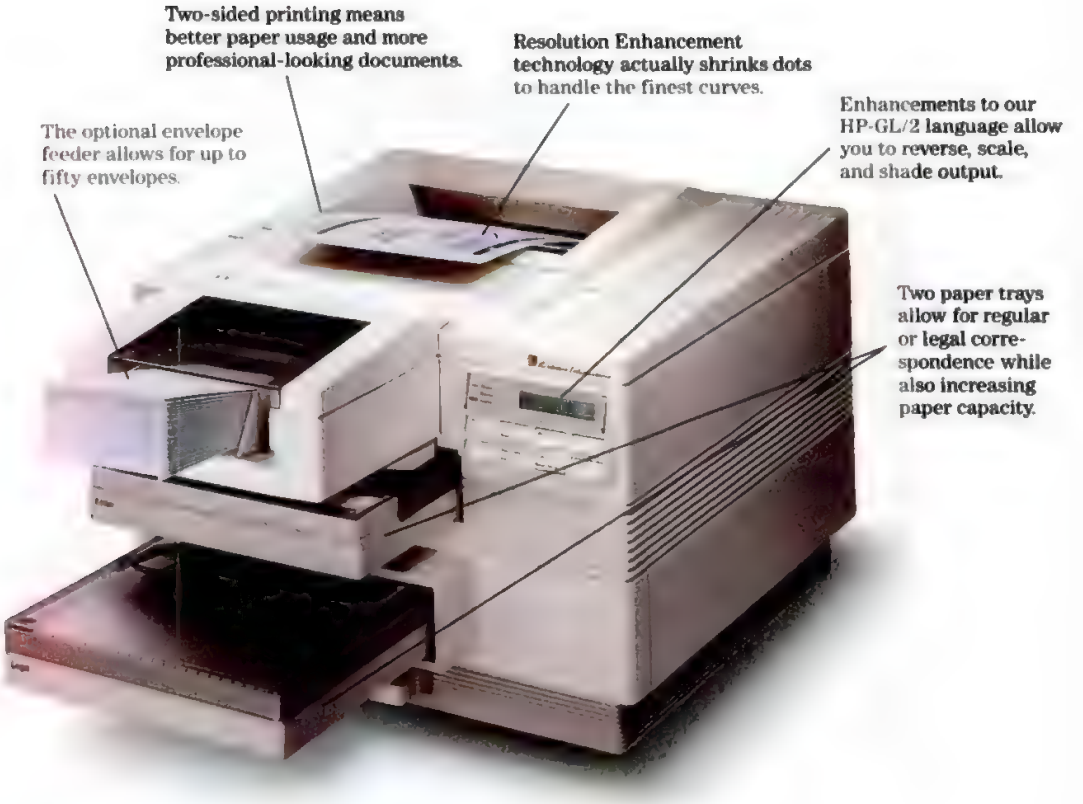

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the common function of shelling out to DOS. In this procedure, you give a special command to your application telling it to stop what it's doing and dump you out to the DOS prompt. (In *Lotus 1-2-3*, for example, the command is /System.) When you are finished, you type something like "Exit" and go back to the application right where you left off.

The problem with shelling out to DOS is that the first application usually remains in memory so that you have very little memory left to do other things. You can exit your spreadsheet, but with two programs vying for limited 640K resources available to DOS, there isn't enough memory left to bring up your database.

Another approach is to use TSR (terminate and stay resident) utilities like Borland's *SideKick* for some of your most frequent tasks. The problem here is that TSRs can lead to RAM cram, taking up valuable space in 640K RAM where all your TSRs and applications reside. TSRs tend to cause memory problems and offer only limited functionality. You can look up a phone number, but can't do a full database search.

Task switchers such as SoftLogic Solutions' well-known *Software Carousel* allow you to swap the current application out in a matter of seconds and bring in another full application. You can move quickly from task to task, but you can't use your PC for another task while waiting on a lengthy request like a database search. With task switchers, you can load several applications at once, but those in the background are frozen. So you get the look of multitasking without the power. Task switching is one way users of 286-based machines can simulate the feel of true 386-based multitasking without the 386 hardware. In the next issue of *PC Magazine*, we'll evaluate six leading task switching packages.

And then there's Unix, the multiuser, multitasking operating system that dominates the high-end workstation market, yet hasn't yet made a significant migration onto the PC platform. Based on CPUs with the large address spaces essential to multiuser and multitasking abilities, Unix could not run effectively on DOS machines until the 386 machine entered the scene. This made it possible to run DOS virtual machines in a Unix environment. Hoping to capture DOS users who might move to OS/2, Sun Microsystems developed the 386-based Unix workstation offering another multitasking alternative.

BUILT INTO OS/2

OS/2 is another alternative to multitasking DOS environments. It has built in multitasking capabilities, but currently does not run more than one DOS application at a time. It does, however, resolve many of the weaknesses of multitasking DOS environments, weaknesses that originate with DOS itself.

OS/2 resolves these problems by migrating the DOS file system into a multitasking environment. You gain the immediate benefits of concurrent CPU processing while disk I/O is being completed, and the result is a more robust and reliable system. The drawback is that until OS/2, Release 2.0, arrives, OS/2 will support only one DOS application at a time. However, you can run multiple OS/2-specific applications.

Windows 3.0 has its own set of *Windows*-specific applications with the same types of advantages and disadvantages, but with the limitations of the DOS file system—the Achilles' heel of *Windows*.

Replacing all your existing DOS applications with OS/2 or *Windows*-specific applications is obviously a radical step no one is prepared to take all at once right now, but it's clear that over time, DOS will gradually be replaced with systems designed for large address spaces and multitasking. These five products give you a taste of that future today.

DOS EXTENDERS TO THE RESCUE

by Brian Carr

There are a variety of DOS applications designed to take advantage of the large flat-address space capabilities of the 386 processor. These applications rely on built-in DOS extenders that take the 386 into protected mode. Borland's *Paradox 386* database package is a good example.

Originally, all of these DOS extenders were incompatible with any program that took the 386 into protect mode. The Virtual Control Program Interface (VCPI), initiated by Quarterdeck and Pharlap and finalized in June 1989, provides a way for such programs to obtain the required flat-address space without interfering with other protected-mode programs. VCPI allows environments such as *DESQview 386* and *Omniview 386* to support *Paradox 386* and other applications that require the large flat-address space.

The chief drawback of the VCPI is that it provides no protection between applications. There is nothing to prevent any application from crashing the system—*DESQview 386*, for example, might do it. For these reasons, *Vmos/3*, *VM/386*, and *Windows* do not support the VCPI.

The DOS Protected Mode Interface (DPMI), initiated by Microsoft with contributions from other industry players, is intended to provide a way for these applications to get the large flat-address space without crashing the system if one application fails. This interface is supported by *Windows* 3.0, although it has not yet been finalized. Therefore, *Windows* supports Version 0.9 with the first formal version expected to be 1.0.

Over time, all 386-specific DOS applications should be adapted to run with all 386 DOS multitasking environments through some combination of VCPI and DPMI. But for now you should check to ensure that your 386-specific applications are compatible with the multitasking environment you choose. ■

DESQview 386

Originally released in the summer of 1985, Quarterdeck's *DESQview* 2.2 was one of the first environments to run multiple DOS applications. Since that time, this $219.95 program has been significantly expanded and remains a long-term market leader with about a million and a half users. You can buy *DESQview*-specific programs called *DESQview Companions* for $99.95 each. These include notepad, calculator, calendar and communications programs, similar to the set of accessories included with *Microsoft Windows* 3.0. Quarterdeck also maintains a bulletin board service for the exchange of proprietary, special pur-

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pose, and shareware *DESQview* programs.

DESQview 386 is actually a combination of two separate products: *DESQview*, the general purpose DOS multitasker that runs on any PC-compatible machine, and *QEMM-386*, an extended memory manager for the 386 that's a useful tool even without *DESQview*. *QEMM-386* converts extended memory into enhanced expanded memory by simulating EMS LIM 4.0 or EEMS memory with 386 extended memory. This frees up address space for DOS programs by moving resident routines and buffers above 640K. *QEMM-386* saves you the cost of special memory boards that let your application programs access this high memory.

CUT AND PASTE

With *DESQview* you can mark text in one window (the logical display for one application) and transfer the marked text to another application. If you master this cut-and-paste capability, you have a very convenient way to move information from one application to another. The exchange is quite limited compared to data exchanges that are possible between *Windows*-specific applications such as Aldus *PageMaker* and *Microsoft Excel*, but will work with almost any application you'll want to use.

DESQview also offers keyboard macros that allow you to assign sequences of keystrokes to a single key that the environment memorizes in a learn mode. The macro and learn capabilities are especially useful since they work the same way for all of your applications.

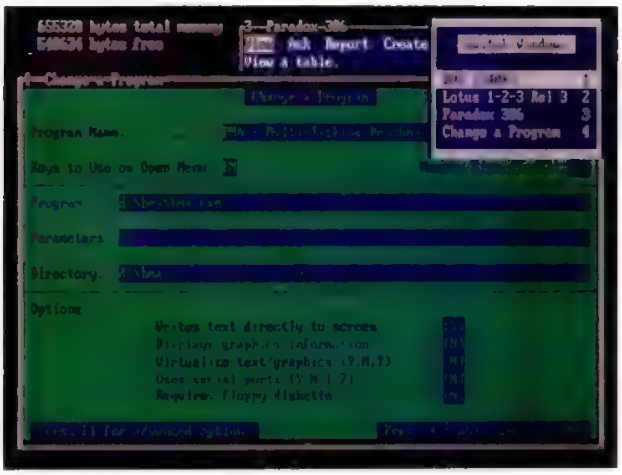
The keyboard macros can even be integrated with the cut-and-paste capabilities of the *DESQview* program. With these tools you can, for example, write a macro to automatically initiate a search in your database, transfer the results to your spreadsheet, and transfer the updated spreadsheet results into a table in your word processor.

CAPABILITIES BLOSSOM

DESQview features standard pull-down text-only menus. Future releases of *DESQview* are expected to venture into graphical interfaces and Xwindows. *DESQview* works with a mouse, though using one is hardly necessary. The environment has always offered text windowing, but with the advent of the 386, this capability has really blossomed, allowing you to window multiple ill-behaved applications—applications that write to the display directly—and graphical applications. The default hotkey to exit an active DOS session is the Alt key, though the hot-key definition is configurable.

DESQview 386 comes with three manuals, and considering the number of *DESQview* users, it's surprising that Quarterdeck has not developed a consolidated manual. The smallest manual contains the basic information you need to install and use the system.

The main manual describes the basic features and functions of *DESQview*. It is well organized as a tutorial and can be very helpful for learning *DESQview* features. The third manual describes *QEMM-386* in great detail. You would probably not need this manual at all except as a reference manual in the event that you encounter some incompatibilities or wish to further fine-tune the system.



***DESQview 386* provides text windowing of application screens. The upper-right pop-up menu is used to select sessions. The lower part of the screen is the Change Program window, used here to describe the multitasking benchmark program. The double box around the window indicates that it is the active window.**

FACT FILE
EDITOR'S CHOICE

***DESQview 386*,**
Version 2.2
Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405; (213) 392-9701.
List Price: $219.95
Requires: 0K-130K RAM, DOS 2.1 or later.
In Short: *DESQview 386* is the environment to buy if you want efficient multitasking of DOS applications, text windowing, cut-and-paste capabilities, and keyboard macros.

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INTELLIGENT INSTALLATION

The clean and simple installation procedure for *DESQview* analyzes your hardware and software automatically and doesn't trouble you with any unnecessary questions. The screens are well designed and apprise you of the progress of the installation. The installation procedure intelligently alters your CONFIG.SYS and AUTOEXEC.BAT and saves the original files under other names.

There is an optional step of running the Optimize program, a truly impressive tool to maximize the memory available to DOS applications. It runs flawlessly once invoked, though it can be disconcerting on first use as it reboots the machine twice and is all automatic.

PERFORMANCE ANOMALY

DESQview 386 was one of the better performers in the environments that we evaluated here. However, disk performance was not particularly impressive. Other than *Omniview* and *DESQview 386*, all of the tested systems included a disk cache (and we tested the systems in their default configurations). If you add an external disk cache to *DESQview 386*, the disk performance should be one of the best.

DESQview 386 maintained reasonably consistent performance in the foreground with the exception of the DOS File Access (long records) test. This anomaly occurs because *DESQview 386* breaks up long file requests into multiple requests so that other tasks are not starved unreasonably from access to the CPU while the request is processed. This slows disk access dramatically.

DESQview 386 allows you to adjust

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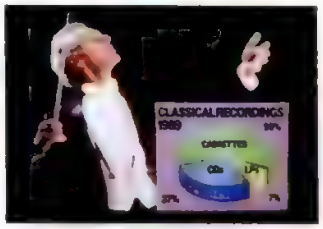

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the time slices—the number of timer interrupts before the CPU is taken from the active task and given to the next task—only for foreground and background tasks. You have little latitude in specifying preferences or priorities on a per application basis. *Windows* and *Omniview* offer more latitude in configuration with respect to time slicing.

DESQview 386 is the proper environment to purchase if you are looking for efficient multitasking of DOS applications, text windowing, cut-and-paste capabilities, and keyboard macros. It has quite a substantial user base and can significantly increase your overall productivity while relying on your existing DOS applications.

Microsoft Windows

At $149, *Microsoft Windows* 3.0 is a real bargain when you consider all the functionality it offers. It includes a disk cache along with several useful applications, such as a note writer, calendar program, and asynchronous communications program.

Windows has been available to users (though initially without multitasking) since the fall of 1985 and is estimated to have two and a half million users. *Windows* is, of course, a graphical environment, and while it can multitask DOS applications gracefully, that is hardly its primary focus.

REFINED GUI

The graphical user interface (GUI) of *Microsoft Windows* 3.0 is very carefully thought out and provides a substantial improvement over previous releases. With variably spaced fonts, buttons shaded to appear 3-D, and improved color usage, *Windows* 3.0 conveys an image of refined quality.

When you use *Windows* 3.0 without a mouse, the thoughtfully laid out user interface is transformed into a series of puzzles. Once you are in your DOS session, all keystrokes go to the DOS appli-

386 MULTITASKING ENVIRONMENTS: SUMMARY OF FEATURES

Products listed in ascending price order

	Omniview 386	Microsoft Windows 3.0	Vmos/3	DESQview 386	VM/386 MultiTasker
List Price	$119.95	$149.00	$199.00	$219.95	$245.00
RAM required for four 640K DOS sessions	3MB	2MB	1MB	2.5MB	4MB
Runs on network	■	■	■	■	■
Runs on MCA machines	■	■	❑	■	■
Supports Super VGA	■	■	❑	■	❑
Interface	Pull-down menus, character-based	Pull-down menus, icons	Character-based	Pop-up menus, character-based	Character-based
Text windowing capability	❑	■	❑	■	❑
Maximum number of text windows	N/A	Unlimited	N/A	50	N/A
Graphics windowing capability	❑	■	❑	■	❑
Maximum number of graphics windows	N/A	Unlimited	N/A	60	N/A
Can window any DOS application	❑	■	❑	■	❑
Can communicate between tasks	■	■	■	■	■
Can file-share between tasks	■	■	■	■	■
Provides LIM EMS 4.0 driver	■	■	■	■	■
Supports VCPI for applications	■	❑	❑	■	❑
Supports DPMI for applications	❑	❑	❑	❑	❑
Supports demand paging	■	■	■	❑	❑
Maximum number of concurrent sessions	10	Unlimited	Unlimited	50	16
Can reboot individual virtual machines	❑	❑	❑	■	■
Print spooler available	■	■	❑	❑	❑
Prints from multiple sessions simultaneously:					
To the same printer	❑	■	❑	❑	■
To separate printers	■	■	❑	❑	■
Allows user-customizable time slicing	■	■	❑	■	■
Allows user-customizable prioritization	■	■	■	■	■
Customizable hotkeys	■	❑	❑	■	■
Allows simultaneous DOS use	■	■	■	■	■
Runs DOS and OS/2 concurrently	❑	■	❑	❑	❑
Allows standard DOS commands	■	■	■	■	■
Replaces standard DOS commands	■	❑	❑	❑	❑
On-line help	❑	■	■	■	■
Context-sensitive help	■	❑	■	■	■
Tutorial provided	❑	❑	■	■	■
Free technical support	■	■	■	■(90 days)	■(90 days)

☆—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

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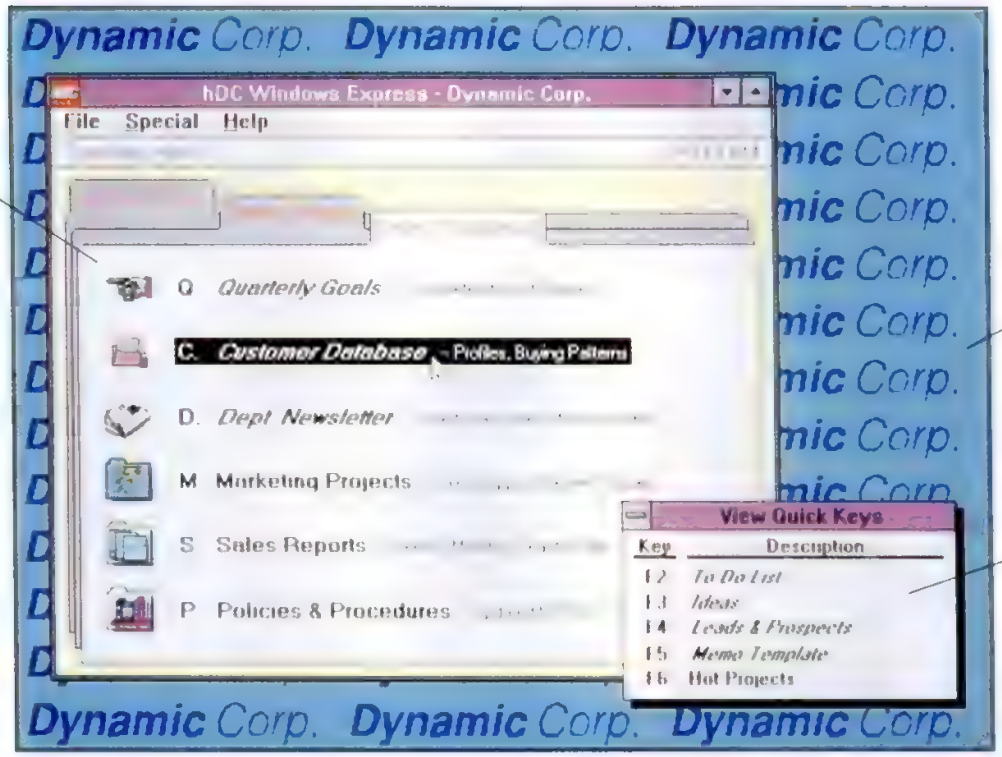

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- 5.25" half-height 44MB

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Effective Access Time –
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- Windows®, NetWare®

Installed Base –
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- 3,750,000 disks

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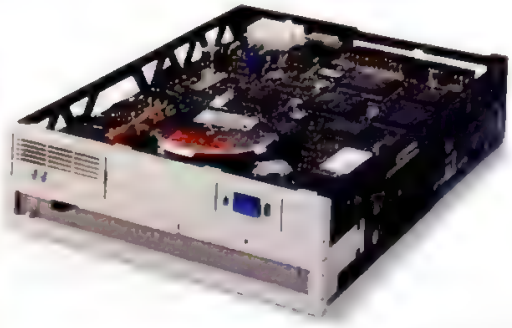
BERNOULLI



When space allows, the Bernoulli Insider fits neatly into leading PC and PS/2 computers. As a total storage solution, it's much better than a hard disk plus tape because you get the benefits of both, along with the unlimited data growth and security of removable storage.

Bernoulli's removable disks are the most rugged available. And we back that up with an unheard-of 5-year Gold Standard Limited Warranty.

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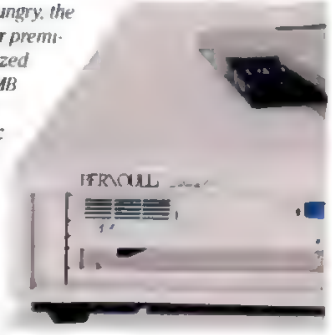

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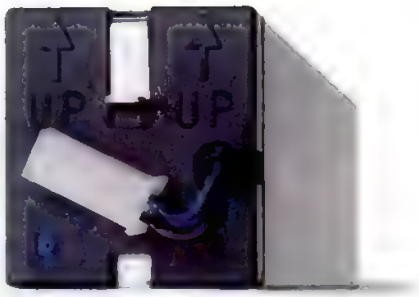
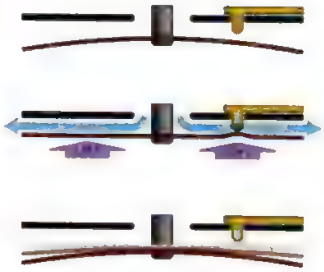


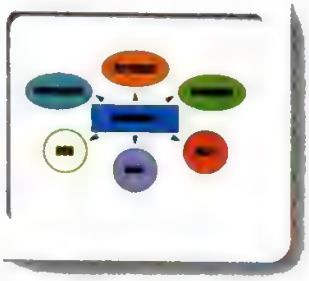
disk drive into a convenient, AC-powered unit. And the price? We've greatly reduced it on all Bernoulli products (up to 22 percent), so they're more affordable than ever

What if you're caught someplace with a lot of work to do and no outlets to be found? No problem. Each removable battery in the Bernoulli Portable provides approximately two hours of operation. And you can run it off the AC adapter while the battery is charging.

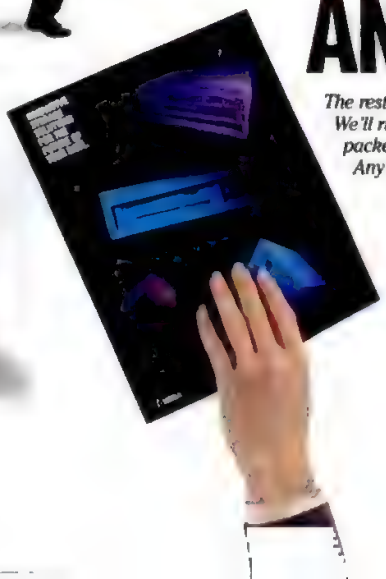


You don't want to entrust your data to anything you have to pamper. That's the beauty of Bernoulli. Its patented design spins a flexible disk at high speed, drawing it toward the head. Should your system encounter a bump, air impurity, or power-loss, the flexible disk simply falls away from the head. The result? Hard-disk performance without the risks.

With all the computing choices out there, the last thing you need is a storage device that limits your options. Our new universality is a unique innovation which lets you easily attach the same Bernoulli to most any system, giving your data (and budget) protection for tomorrow.



Who says you can't take it with you? The new Transportable and Portable were specifically designed for a shrinking world on the move. But just because they're lightweight doesn't mean they're light on performance. Bernoulli implements the latest drive enhancements to help you keep pace with your busy schedule.



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cation with the exception of the two hotkey combinations of Ctrl-Esc and Alt-Esc. These combinations exit the DOS session and bring you back into normal mode. These hotkeys are adequately documented in the manual.

To use *Windows* 3.0, you need only know the basics of using a mouse, but to master this very large and complex system takes time. The 621-page manual that ships with *Windows* 3.0 examines complexities that the interface hides from the user.

The state-of-the-art installation procedure contains extensive logic in order to determine the hardware it's running on and automatically configures the system while asking you a minimal number of questions. A graphical display of the percentage complete keeps you informed of the current status of the installation. At your option, the install program can update your CONFIG.SYS and AUTOEXEC.BAT. The overall effect is one of refined quality, which is sure to leave new users with a very positive first impression.

***Microsoft Windows* 3.0 normally runs a VGA display in graphics mode. The lower-right window shows the PIF Editor accessory used to configure the multitasking benchmark program so it could run in the background. The PIF editor was invoked by the Program Manager (upper left) after selecting the Accessory submenu.**

UNEXPECTED RESULTS

In such a large and complex environment, it's not surprising that there are a few ways to hang the system. Certain combinations of normally acceptable operations cause unexpected results and may cause the system to cease working.

Of all the environments evaluated in this review, *Windows* 3.0 is the system most prone to such failures, a drawback that should improve with later releases of the program. However, the frequency of these problems is not great enough to prevent the system from being useful to most users.

If you run it in its enhanced mode (the normal mode on a 386 machine), *Windows* 3.0 utilizes the 386 page tables to write inactive memory out to disk, making the system appear to have more memory than it really does. This demand-paging feature is also offered by the *Vmos/3* program.

There is quite an extensive list of *Windows*-specific applications from Microsoft and dozens of other vendors that will perform most standard PC operations like spreadsheets, word processing, and desktop publishing.

If you take the step to convert to these *Windows* applications you will benefit from a consistent user interface across all your applications and have convenient integration between applications supporting the Dynamic Data Exchange (DDE) API.

FACT FILE

***Microsoft Windows*, Version 3.0**
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; (206) 882-8080.
List Price: $149.
Requires: 640K RAM (2MB for 386 enhanced mode), DOS 3.3 or later.
In Short: *Microsoft Windows* 3.0 has acceptable performance and a highly refined graphical user interface. If you do a lot of work with graphics or want to start using a GUI, *Windows* 3.0 is the right environment for you.

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ENERGY DRAIN

Windows' performance as a multitasking DOS environment is adequate. It doesn't rank first on all the tests because energy is used for functionality far beyond just running DOS applications simultaneously. This is important to keep in mind.

Equipped with a disk cache program, called SmartDrv.Sys, *Windows* has the best overall disk performance. This disk cache made use of available extended memory (up to 2MB) and was utilized during the benchmark testing. When the disk cache was not loaded or when extended memory was not available (as on the 386SX test system with only 2MB of memory), *Windows* had the worst disk performance.

Omniview and *DESQview* allow the addition of disk caches and would have performed better with a disk cache. However, externally added disk caches cannot dynamically adjust the amount of memory used in conjunction with the memory used by the environment as *Windows* and SmartDrv.Sys do.

TIME SLICING

Windows maintained reasonably consistent performance in the foreground. That is, the visible application did not change significantly depending on what the background task was doing. Further, *Windows* allows you to specify both the foreground and background priority of each application. With this priority you can specify the precedence given to the foreground and relative percentages of the CPU given to each active task.

Equipped with a disk cache program, *Windows* has the best overall disk performance. This disk cache makes use of available extended memory (up to 2MB).

Windows has problems with asynchronous communications programs and pro-

If you're thinking about utilities, consider the utilities that do the thinking for you.

The Norton Utilities® 5.0 is more than just a powerful new version of a classic, award-winning bestseller.

It's the best thing to happen to PC utilities since we invented them in the first place.

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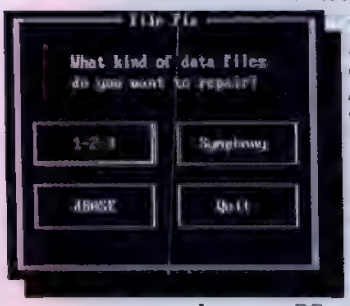
Intelligence.

It's built in to each and every one of the 20 utilities in this package.

Which means that each and every person who uses a PC—yes, even outright novices—can use the Norton Utilities to perform a variety of sophisticated support tasks.



The new Norton Utilities corrects problems other programs can't even detect. File Fix, for example, fully reconstructs damaged 1-2-3, Symphony® and dBase files.

Without the aid of a sophisticated support person.

Whether you want to maximize your PC's performance, minimize the chances of data loss and disk failure, or just get yourself out of a jam, you need to get yourself the new Norton Utilities.

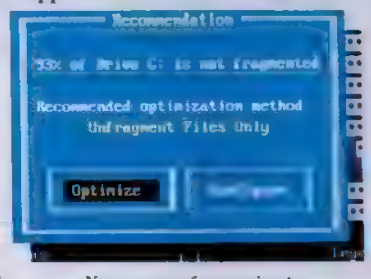
Having the Utilities on your disk—or on your network—is like having Peter Norton at your elbow.

In fact, our enhanced user interface includes a unique new feature that works with you just the way Peter would.

Advise not only helps you identify your particular problem, it also recommends the appropriate course of action and executes the appropriate utility.

Automatically.

If the problem happens to be a corrupted hard disk, you'll see right away why the *Norton Disk Doctor II* is the most sophisticated utility of its kind in the world.



Now everyone from novices to experts can safely perform in-depth preventative maintenance and file recovery with a few simple mouse clicks.

Disk Doctor II finds and fixes problems other programs can't even detect. Yet it's simple enough for beginners to use.

The same goes for *File Fix*, an invaluable new tool that delves into the complex internal structure of your Lotus® 1-2-3,® dBase® and compatible spreadsheets and databases to make repairs that would stymie even a skilled technician.

UnErase performs data searches automatically and shows you a list of all the deleted files on your disk. So all you have to do is point and shoot.

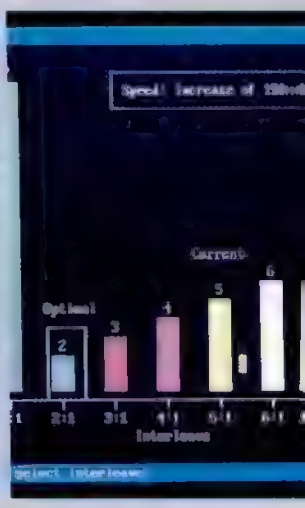
It also does something no other program can do: recover deleted files from anywhere on your network.

If all of that sounds like reason enough to join the army of happy Norton Utilities users, it is.

And we haven't even told you about the feature those users have most often requested.

Calibrate™ analyzes and adjusts the "interleave" of your hard disk, optimizing the read/write speed and dramatically improving performance.

Of course, when it comes to improving performance, there's nothing quite like *Speed Disk*.™



Our new Calibrate utility revitalizes demagnetized disk areas and uses a low-level formatter to adjust your disk when the heads go out of alignment.

It not only offers four different optimization methods, it figures out exactly how fragmented your disk has become and tells you which method to use.

Nobody has to tell you how serious it is when the power goes out. So you'll be glad to know that *Calibrate, Speed Disk* and *Disk Doctor II* are designed with a unique failsafe architecture.

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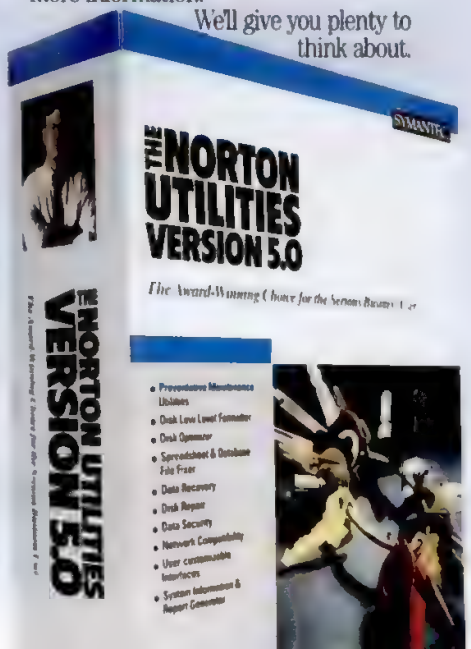
So don't lose another minute. Call 1-800-343-4714 Ext. 702P and demand more information.

We'll give you plenty to think about.



BUY VERSION 5.0 NOW AND GET A NORTON BACKUP FREE! (See package for details.)

The new Norton Utilities 5.0 from Symantec

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grams with unusual hardware dependencies. Since *Windows* does not support VCPI (see the sidebar "DOS Extenders to the Rescue"), don't expect 386-specific software, such as *Paradox 386*, to run on it. As DPMI is accepted, the problem with 386-specific applications should be relieved, but for now caution is advised.

Windows 3.0 adequately runs multiple DOS applications. The chief attraction is its highly refined graphical user interface (GUI). If you already have *Windows* applications, do a lot of graphical work, or just want to start using the widely discussed GUI, *Windows* is a great buy.

Omniview 386

Omniview 386, Version 4.2, is the essence of multitasking DOS environments. It doesn't have fancy windowing or complex device allocations, just fast and simple application juggling. At $119.95, it is also the least expensive of the environments evaluated in this review, and the price includes the extended-memory manager *386-Mate*. For non-386 systems, you can buy *Omniview* for $79.95 and get the same multitasking environment without *386-Mate*.

386-Mate is a useful tool even without *Omniview*. It simulates EMS LIM 4.0 or EEMS memory with 386 extended memory and can free up address space for DOS programs by moving resident routines above 640K. *386-Mate* is not as capable as *QEMM-386* (included with *DESQview 386*) to move buffers and TSR routines above 640K, but it is quite functional.

Omniview 386 also includes several general purpose utilities such as Wheres, which searches for described files beyond the current directory.

The combination of *Omniview* and *386-Mate* was first released this summer. Current users of *Omniview* can upgrade to *Omniview 386* for an introductory price of $45. *Omniview* has a long history of working with other extended-memory managers such as Qualitas's *386Max*. If you already have an EMM and want to save $40 you might check into buying *Omniview* by itself.

INTERFACE CHOICE

The user interface for *Omniview 386* has full-screen menus where you select the desired entry via characters or cursor movement keys. You select the desired DOS session by pressing Ctrl-Shift and the number of the session. Session number one is the system menu used to create new sessions.

You can also run *Omniview 386* without the menu system, which saves memory and lets you execute the equivalent functions from the command-line interface. While this probably won't appeal to most users, the combination of command-line functions and the system menus is most appealing.

It allows you to maintain one or more DOS sessions for running miscellaneous applications and update the system description as you run different applications. For example, you might have a session in which you normally run background compiles but occassionally want to run your favorite asynchronous communications program to download files.

Without command-line functions you would need a separate session that requires special treatment for asynchronous communications. With command-line functions you could write a batch file that would set up the appropriate parameters before loading the program and restore them on termination.

MOSTLY SELF-EXPLANATORY

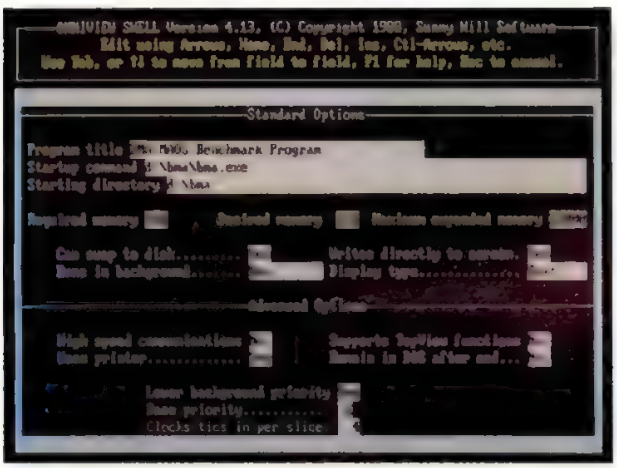
Omniview 386 comes with a 156-page manual that includes critical information about switching between sessions. Once you know about the Ctrl-Shift number combination, the rest of the system is self-explanatory. Otherwise, the manual is a well-organized reference, containing a large section on setting up and running a large set of common applications with all the suggested options.

The installation procedure does not automatically update your CONFIG.SYS or AUTOEXEC.BAT. Instead it provides easy access to the READ.ME file, which explains the required changes. It can also put you into an editor to edit those files directly, but it is easier to edit the READ.ME file before starting the installation procedure, and then make changes with your favorite text editor.

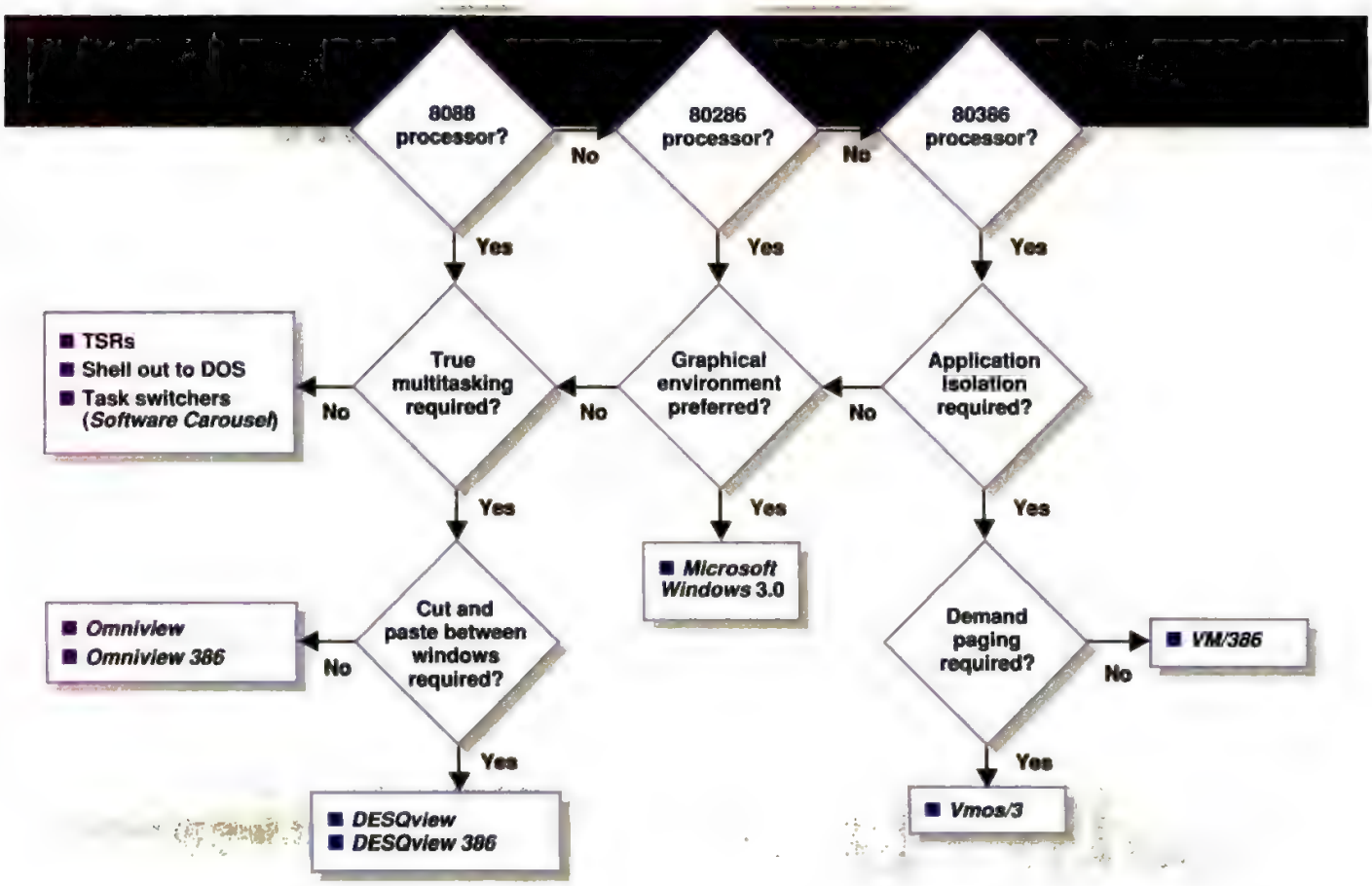
A DECISION GUIDE FOR MULTITASKING SOLUTIONS

The number of available multitasking options depends on the kind of microprocessor you are currently using. Although the 286 is adequate for some multitasking, only the 386 has the power to create virtual machines through virtual 8086 mode. Keep these definitions in mind as you make your decision:

- Task switching offers the look of multitasking without the power. Several applications can be loaded at one time, but those in the background are not active.
- A multitasking system is a single-user solution for actively running several applications simultaneously on one PC.
- Application isolation prevents other active tasks from crashing if one task crashes. Individual virtual machines can be rebooted.



Omniview 386 provides full-screen text menus and has no windowing capabilities. The screen shown is used to describe the multitasking benchmark test for OmniView.



Omniview 386 supports the VCPI (see the sidebar "DOS Extenders to the Rescue") and a very large set of applications. As with *DESQview 386*, *Omniview 386* provides very little protection from faulty applications. However, if you are like most people, you regularly use a relatively small set of applications. Once you've learned how to set up those applications, the system will run flawlessly without any protection.

If you are trying out a new application, particularly one that accesses hardware directly, you should save files to prepare for a system crash. Having experimented for a while, you will know what precautions are necessary for that application.

FACT FILE

***Omniview 386*, Version 4.2**
Sunny Hill Software, P.O. Box 55278, Seattle, WA 98155; (800) 367-0651.
List Price: $119.95.
Requires: 256K RAM, DOS 2.0 to 3.x.
In Short: If you want simple, fast, easy-to-use, and inexpensive multitasking of DOS applications, *Omniview 386* may be the answer for you. It doesn't offer fancy windowing, keyboard macros, or complex device allocation, but it does offer the best overall performance and the lowest price.

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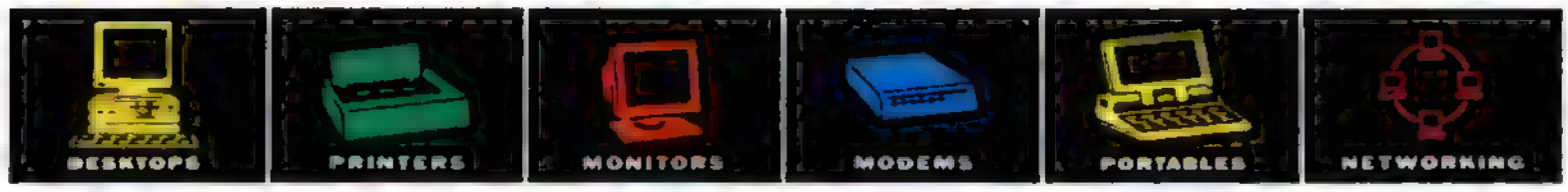
BEST OVERALL

Omniview 386 had the best overall performance of the tested environments. *Windows*, which includes a disk cache, did better on the disk access benchmark tests. Using *Omniview 386* with a disk cache program of your choice is recommended. With the addition of a disk cache, *Omniview 386* should provide the best overall disk performance as well.

Omniview 386 provides excellent flexibility in configuring your priorities. You can specify both priorities and time-slice lengths. The priorities are not absolute; the system will continue to give time to lower priority tasks, only at much reduced levels. The consistency of foreground performance on the benchmark tests for *Omniview 386* is quite impressive.

If you are like most, you regularly use a relatively small set of applications. Once you've learned how to set them up, the system will run flawlessly without protection.

Omniview 386 is an excellent value. It provides fast and simple multitasking of DOS applications without a lot of extras. It has the lowest price of the reviewed systems and the best overall performance.



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VM/386 MultiTasker

IGC designed *VM/386 MultiTasker*, Version 1.22, to take full advantage of 386 systems. First released at the end of 1987, bearing a pricetag of $245, *VM/386* is somewhat of a newcomer to the multitasking environment field, but has established itself in the marketplace by focusing on high-end 386 systems and demanding users.

The primary user interface in *VM/386* is a series of full-screen menus from which you select an entry with either the cursor keys or charcter input.

The hotkey for *VM/386* is the SysReq key, which on most current keyboards is a two-key combination. The manual refers to both SysReq and Alt-SysReq. This can be most confusing, since both combinations are possible on the original AT keyboards. The SysReq key gets you out of the selected DOS session and back into the menu screens. The hotkey is easily identified because you are required to press SysReq to get out of the initial system menus into a DOS session. The system menus will remind you of this.

Some of the critical functions, such as assigning a device to a DOS session, can also be issued as commands in the session (VMLINK in this case) as well as through the usual menu interface.

VM/386 comes with a 269-page man-

VM/386 MultiTasker is somewhat of a newcomer to the multitasking environment field, but has established itself in the marketplace by focusing on high-end 386 systems and demanding users.

BENCHMARK TESTS: 386 MULTITASKING ENVIRONMENTS

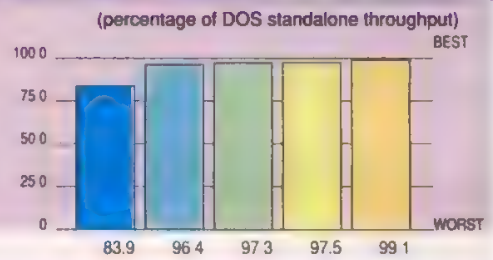
PC LABS

If you want to set up virtual machines on your 386 system or run processor-intensive tasks in the background, *DESQview 386* is the environment for you. But *Omniview 386* scores the best when disk access is most important.

PROCESSOR-INTENSIVE TESTS

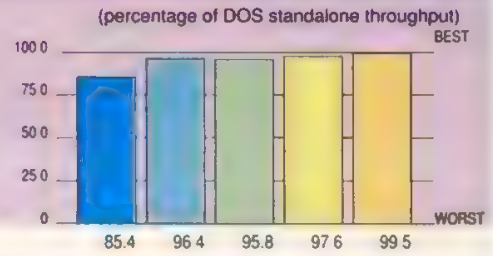
8086 Instruction Mix (Three Active Background Tasks)

The **8086 Instruction Mix** test simulates a CPU-intensive DOS application in which no system calls or I/O occur. The test is run as three simultaneous tasks in the background, while a fourth test is run in the foreground.



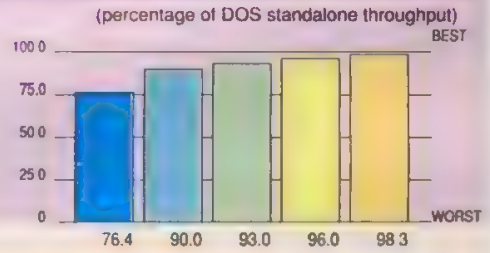
8086 Instruction Mix (One Active Background Task)

For the **8086 Instruction Mix** (One Active Background Task), the same CPU-intensive test is repeated, this time with just one test running as a task in the background and two background sessions waiting for keyboard input



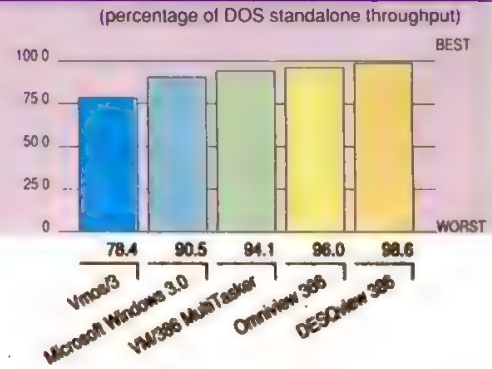
8086 Instruction Mix (SX Machine with Three Active Background Tasks)

For the **8086 Instruction Mix** (SX Machine with Three Background Tasks Active), the same CPU-intensive test is repeated, this time on a 16-MHz 386SX machine with three background tasks active



8086 Instruction Mix (SX Machine with One Active Background Task)

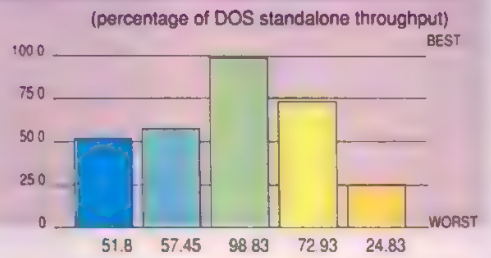
For the **8086 Instruction Mix** (SX Machine with One Background Task Active), the same CPU-intensive test is repeated, this time on a 16-MHz 386SX machine with one test running as a task in the background and two background sessions waiting for keyboard input



PROCESSOR-INTENSIVE TESTS

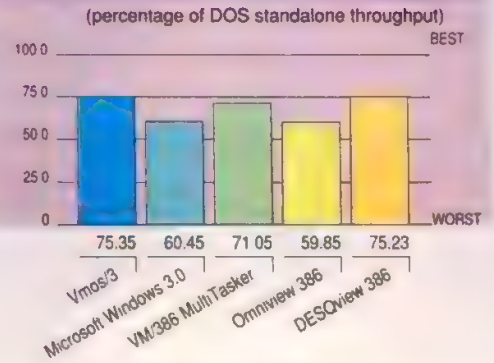
8086 Instruction Mix/DOS File Access (Foreground)

The **8086 Instruction Mix/DOS File Access** test runs the DOS File Access test as a task in the foreground and the 8086 Instruction Mix in the background. Two background sessions are open but inactive and waiting for keyboard input. This test measures the throughput of the foreground task, and is reported as a percentage of DOS's throughput performing the same task by itself.



8086 Instruction Mix/DOS File Access (Background)

The **8086 Instruction Mix/DOS File Access** test runs the DOS File Access test as a task in the background and the 8086 Instruction Mix in the foreground. Two background sessions are open but inactive and waiting for keyboard input. This test measures the throughput of the foreground task, and is reported as a percentage of DOS's throughput performing the same task by itself.



ual that's well organized as a reference, though a novice may be intimidated by the depth of information. A second manual, the Installation Guide, covers many of the same topics and functions primarily as a technical update for the original manual.

The installation procedure for *VM/386* is a relatively simple batch file that copies

_VM/386_ and _Vmos/3_ are the only environments that prevent each application from interfering with any other application or the system.

the required files to the hard disk. Rather than make any changes to your CONFIG.SYS or AUTOEXEC.BAT files, it refers you to the manual and a READ.ME file for the changes you must

HOW WE TESTED

Measuring the speed of multitasking environments is difficult because the performance of one task depends on all the other active tasks at any given moment. To measure these differences, we developed a new testing routine to run the standard PC Labs benchmark tests as several separate tasks simultaneously, but synchronized through a shared file so that any combination of tests could be run at the same time.

With this tool we were able to measure what happens when the 8086 Instruction Mix was run in one, two, three, or four simultaneous sessions, simulating simultaneous CPU-intensive DOS applications. We report the total system throughput as a percentage of how DOS performs these tests standalone.

All of the multitasking environments allow you to adjust the percentage of the CPU given to a task either by prioritizing your tasks or by changing the number of time slices (clock ticks) for each open application. (We tested with default setups wherever possible.) We also report significant variations in the percentage of CPU power given to the foreground task.

Since all of the multitasking environments allow all active tasks to share a hard disk, the environment must serialize (queue up) disk requests so they don't interfere with each other. We ran tests to measure the effects of this serialization on performance.

Along with the *PC Magazine* large- and small-record DOS File Access tests, we included an ultrashort-record file access test that writes 32,768 bytes to a file, 1 byte at a time. This single-byte file I/O happens often in applications such as DOS's COMMAND.COM when it executes a batch file. The test emphasizes the performance hit introduced by sharing the hard disk.

The display and keyboard must be shared among the tasks in the same way, but in these cases, the environments provide logical devices to each application and map the logical devices onto the real display and keyboard when appropriate. We ran the Video Direct to Screen test on the logical displays and report the effect on system throughput of the virtual display as compared with the throughput of DOS alone.

TEST ENVIRONMENT

Most of the tests were run on a Compaq Deskpro 386/25 with 4MB RAM, a 60MB hard disk, and a VGA adapter. To measure performance degradation with an increasing number of background tasks on a slower system, we also tested with a 16-MHz 386SX machine with 2MB RAM, a 40MB hard disk, and a VGA adapter. All of the environments were set up in their default configurations, with the following exceptions:

- In *Vmos/3*, the default setup gives the foreground task 100 percent of the CPU as long as the foreground is busy. However, we needed to test what happened when more than one task was active, so for all tests with more than one active task, we increased the priority of the background tasks to equal that of the foreground.

- In *VM/386 MultiTasker*, the Shared Resource Manager (SRM) disables inactive tasks when it detects that a task has entered a keyboard wait loop. However, a CPU-intensive task looks like a task in a wait loop to the SRM. We increased the SRM time-out value to 12 seconds so that each task could complete the CPU test before being timed out. We also put in an extra test sequence after a task went into a keyboard wait state to allow time for the SRM to recognize that the task should no longer be given the full share of the CPU.

- For *Microsoft Windows* 3.0, we created a Program Information File (PIF), which noted that the test application should be permitted to run in the background.

- *DESQview 386* was tested with the "Virtualized Text/Graphics" option turned on to eliminate bleed-through of background screen writes and cursor positioning. Had this option been turned off, *DESQview 386*'s video performance would have improved markedly.

CONTINUES

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_VM/386_ does not support demand paging (though it is planned for the next release of the product) or swapping of applications to disk, and uses a lot of memory for each session.

make in order for *VM/386* to work. There cannot be any device drivers that take the 386 into protected mode.

THE ACHILLES HEEL

Of the tested packages, *VM/386* and *Vmos/3* are the only environments that prevent each application from interfering with any other application or the system. We call this application isolation. If an application crashes, you can reboot that DOS session by pressing Ctrl-Alt-Del.

However, the Achilles heel of this feature is that the applications share the hard disk. If the application was in DOS when it crashed or when you pressed Ctrl-Alt-Del, there is a good chance that the entire system will be hung so that no other part of the system will be allowed access to DOS.

The conscientious isolation of the DOS sessions can also lead to some difficulties with the keyboard state. When you go

FACT FILE
EDITOR'S CHOICE

VM/386 MultiTasker,
Version 1.22
IGC, 1740 Technology Dr., #300, San Jose, CA 95110; (408) 441-0366.
List Price: $245.
Requires: 2MB RAM (3MB recommended), DOS 3.0 to 4.01.
In Short: An excellent tool for the computer professional who has the time and interest to completely control his system. *VM/386* can handle errant software and disparate special purpose devices. However, caution is advised for those with SCSI controllers and 386-specific applications software.

CIRCLE 402 ON READER SERVICE CARD

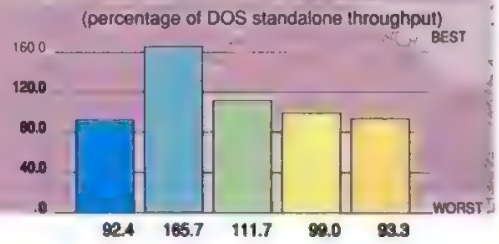
BENCHMARK TESTS: 386 MULTITASKING ENVIRONMENT

PC LABS

DISK-INTENSIVE TESTS

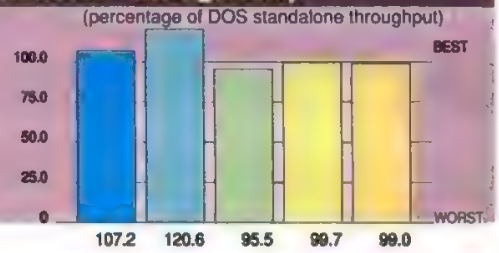
DOS File Access (Small Records—Foreground)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. Three background sessions are open but inactive and waiting for keyboard input.



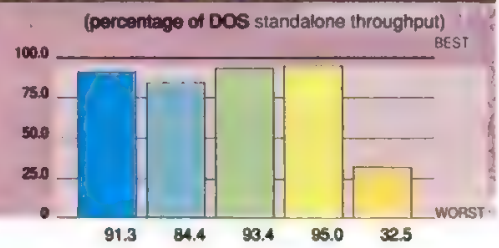
DOS File Access (Small Records—Background)

The **DOS File Access (Small Records)** benchmark test is repeated with an 8086 instruction Mix running in the foreground and a task in the background. Two background sessions are open but inactive and waiting for keyboard input.



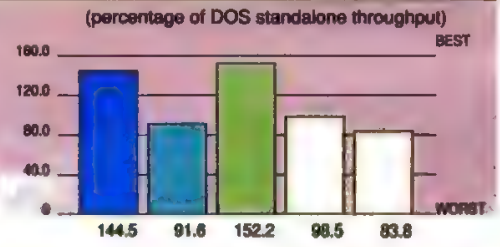
DOS File Access (Large Records—Foreground)

The **DOS File Access (Large Records)** benchmark test times the throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. Three background sessions are open but inactive and waiting for keyboard input.



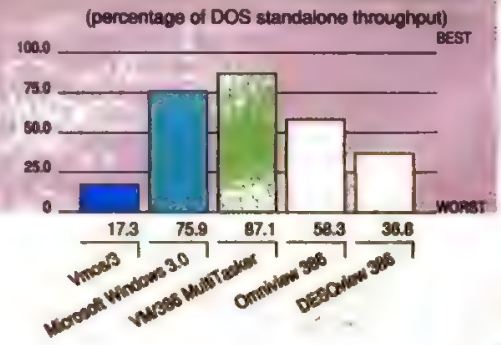
DOS File Access (Large Records—Background)

The **DOS File Access (Large Records)** benchmark test is repeated, this time running as a task in the background. Two background sessions are open but inactive and waiting for keyboard input, and an 8086 Instruction Mix test is running in the foreground.



DOS File Access (Byte-Size Records—Foreground)

The **DOS File Access (Byte-Size Records)** test makes 32,768 single- byte requests to write to a file at a time. This kind of single-byte I/O happens often when COMMAND.COM is accessed. This test emphasizes perfor-mance degradation suffered by sharing the hard disk. Three background sessions are open but inactive and waiting for keyboard input.

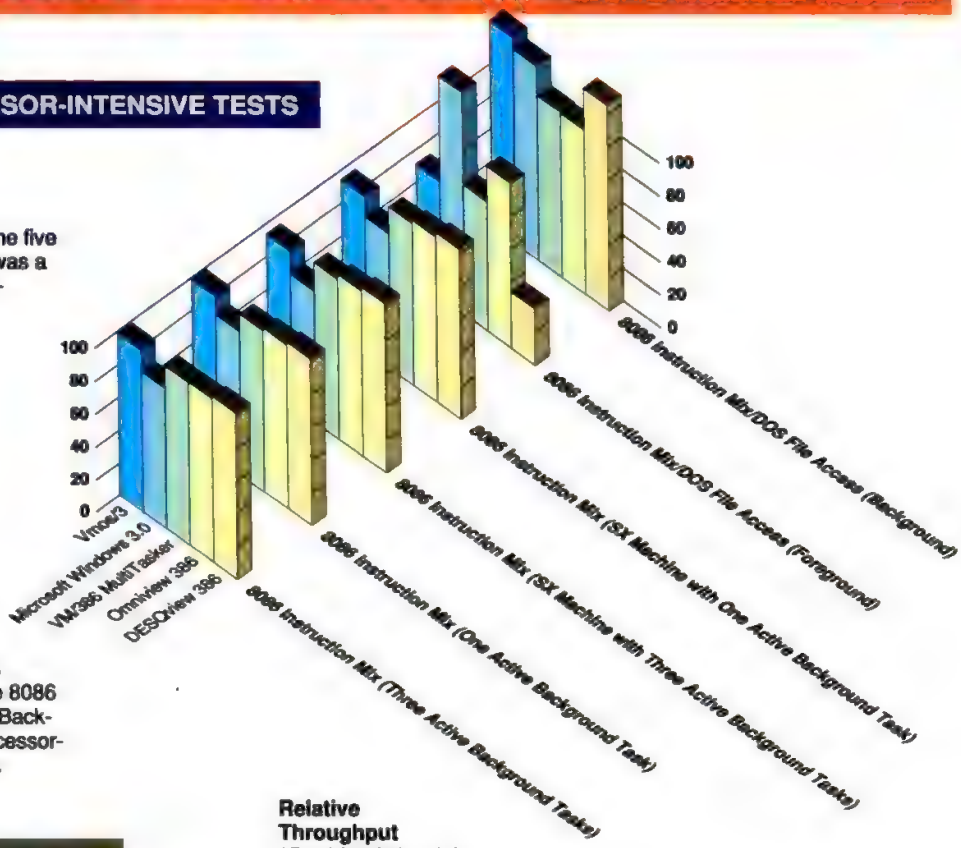


PROCESSOR- AND DISK-INTENSIVE TESTS: COMPOSITE VIEW

PROCESSOR-INTENSIVE TESTS

Measuring the relative speeds of the five multitasking environments tested was a difficult challenge because the performance of every active task is affected by all the other active tasks at any given moment. This first group of tests is built around PC Labs' 8086 Instruction Mix benchmark test and therefore discloses how well the multitaskers do when they juggle processor-intensive applications.

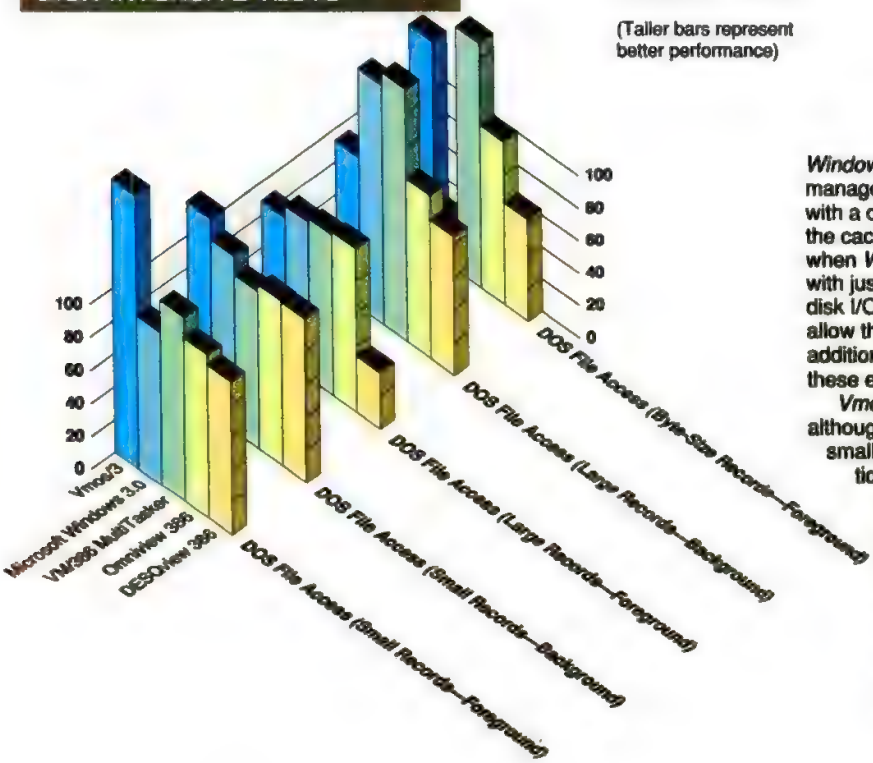
DESQview 386 was consistently the best performer on these processor tests, whether they were run on a 25-MHz 386 system or a 386SX machine. The only place where its throughput dropped off was on the 8086 Instruction Mix/DOS File Access (Background) test, which combines processor-intensive and disk-intensive tasks.



Relative Throughput
(*Omniview 386* = 100)

(Taller bars represent better performance)

DISK-INTENSIVE TESTS



Windows 3.0 demonstrated the best hard disk I/O management with one task active, but it was running with a disk cache program, SMARTDRV.SYS. When the cache was disabled on the 386 machine, and when *Windows* 3.0 was run on the 386SX system with just 2MB RAM, it didn't perform nearly as well in disk I/O testing. *DESQview 386* and *Omniview 386* allow the addition of external disk caches. With the addition of such caches, overall disk performance for these environments would no doubt improve.

Vmos/3 and *VM/386* also include a disk cache, although the default size (tested here) is a much smaller 32K. Both of these environments did particularly well when a disk-intensive task was run at the same time as a CPU-intensive task. With the CPU test in the foreground, system throughput was 40 to 50 percent better than that of DOS alone because the environments could run the CPU-intensive task at the same time that they recognized the slower disk I/O task was active. This maximized utilization of the CPU. The other environments did not take advantage of this opportunity for improved throughput.

CONTINUES

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PC MAGAZINE EDITOR'S CHOICE

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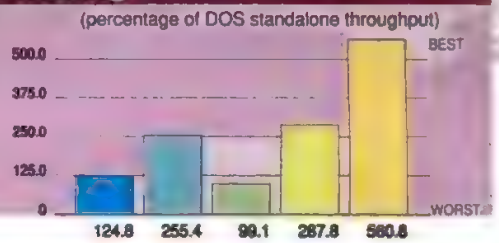
BENCHMARK TESTS: 386 MULTITASKING ENVIRONMENTS

PC LABS

VIDEO-INTENSIVE TESTS

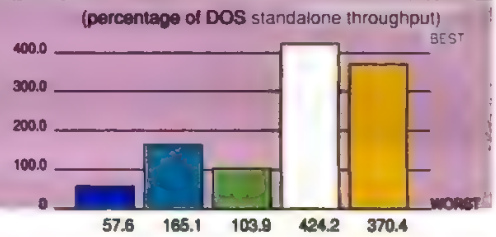
Video BIOS Routine with Scrolling

The **Video BIOS Routine with Scrolling** test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files. Three background sessions are open but inactive and waiting for keyboard input.



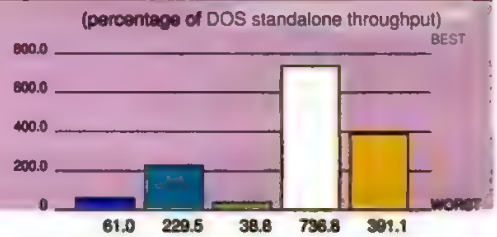
Video Direct to DOS (Foreground)

The **Video Direct to DOS** benchmark test measures the time it takes to write 240 lines of text one line at a time to a full screen. The test runs in the foreground while three background sessions are inactive and waiting for keyboard input.



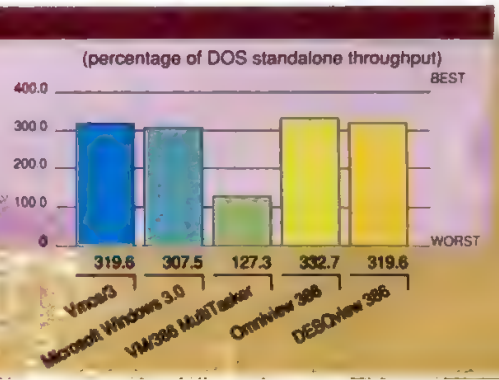
Video Direct to DOS (Background)

The **Video Direct to DOS** benchmark test is repeated. This time, the foreground session and two background sessions are inactive and waiting for input, while the test runs in the background.



Video Direct to Screen

The **Video Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen. The test is run as a task in the background. Two other background sessions are waiting for keyboard input, as is the foreground.



back to a session, it may think the Alt key is depressed as it was when you left the session after pressing Alt-SysReq to get to the system menus. Keys will not work as you expect until you press and release the appropriate key (Ctrl, Shift, or Alt). When this has been done, then the session will be notified that the key has been released.

VM/386 does not support demand paging or swapping of applications to disk, and uses a lot of memory for each session. Not only is there a separate copy of DOS in each session (decreasing the useful area for the application), but there is also about 40K of system buffers per session. On a 4MB system this will hardly be noticeable, but on the 386SX test system with only 2MB of RAM, running four copies of the benchmark test was challenging. Demand paging is planned for the next release of *VM/386* and should eliminate many of the memory problems, although performance may be degraded.

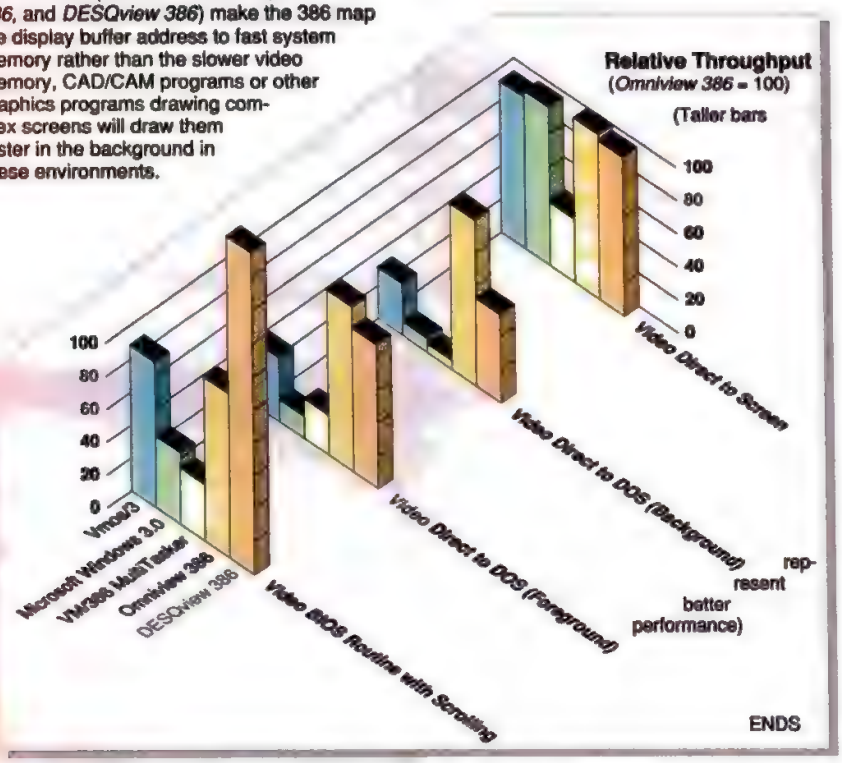
PC LABS

By mixing and matching the benchmark tests and the locations where they were active (foreground or background), we were able to discover some interesting results. On the video tests, all the environments outperformed DOS, a surprising result since they must create a logical display for each active task and then map that logical display to the monitor when appropriate (resulting test scores are therefore higher than 100 percent). For BIOS display requests, this is possible by replacing the inefficient BIOS code on the system ROM.

Omniview 386 was almost seven and a half times as fast as DOS on the Video Direct to DOS (Background) test. By not passing the direct screen-write request to DOS but updating the logical display directly instead, it improved its performance markedly.

Because the environments that outperformed DOS (*Microsoft Windows, Omniview 386*, and *DESQview 386*) make the 386 map the display buffer address to fast system memory rather than the slower video memory, CAD/CAM programs or other graphics programs drawing complex screens will draw them faster in the background in these environments.

***VM/386* displays full-screen menus with yellow to highlight the active submenu. This screen shows the profile used to describe the multitasking benchmark session with just enough memory for the file buffers.**



UNDERSTANDABLE PERFORMANCE

Overall, *VM/386* has below-average performance. This is understandable since the environment takes a significant performance hit on overhead to provide application isolation. The other environment with similar application isolation, *Vmos/3*, performed even worse.

VM/386 performed very well when one task required significant disk activity while another task demanded more CPU-intensive activity. It recognized when the disk task was waiting on disk I/O and gave the CPU to the other task allowing a 50 percent increase in total system throughput. *Vmos/3* was the only other environment that took advantage of the ability to utilize each part of the system fully.

TIME SLICING

VM/386 has very intelligent dispatching algorithms that give the CPU to each application in very regular intervals so that screen updates occur smoothly. However, almost no preference is given to the foreground application.

VM/386 does not directly detect when an application goes into BIOS to wait for keyboard input. Instead, it relies on its Shared Resource Manager to detect such situations. This means that there is a waiting period for keyboard input during which *VM/386* will still give the task regular time slices. The opposite side of this problem is that CPU-intensive applications (such as a spreadsheet recalculation in memory) may stop receiving regular time slices. Both these problems required special attention in our testing procedures.

An additional method of detecting keyboard wait states is planned for the next release of *VM/386*. It should eliminate the problems with the Shared Resource Manager.

Before buying *VM/386* you should ensure that your hardware is supported. Bootable SCSI controllers (with drivers in ROM) are supported by copying in a special driver. SCSI controllers that require device drivers in your CONFIG.SYS can only be accessed by a single DOS session unless you buy the NetPack option for $150. *VM/386* also has problems with more than two disk drives on a system and with the IBM external 5.25-inch floppy disk drive.

Since *VM/386* does not support VCPI, don't expect most 386-specific software, such as *Paradox 386*, to run on it. As DPMI gains acceptance, this problem may be alleviated, but for now caution is recommended.

VM/386 is an ideal environment for the power user who has the time to take charge of the 386 system. It has all the controls required to configure the system to your specifications. It also provides very good application isolation, making it a robust system suitable for use as a process controller or special purpose device controller. It is not for the casual user who wants a little extra functionality beyond that of DOS.

Vmos/3

Vmos/3 , Version 1.0k2 is an unusual sort of hybrid. It has the demand paging provided by *Microsoft Windows*, application isolation, *VM/386* device controllers, and its own user interface that endeavors to keep the system simple and understandable. It is also the most recent entry in this field, having been on the market only since the spring of 1989. The hardware restrictions of the $199 *Vmos/3* package can be largely attributed to its newcomer status. For most *Vmos/3* commands you specify the command and its parameters with single-character selections from options displayed on the bottom line of the screen. The Enter key is normally required only after the last selection.

Vmos/3 allows you to control devices and their assignments down to the last detail to include DMA channels, IRQ levels, and I/O ports. However, the average user does not need to venture into these command selections.

Vmos/3 comes with a single, well-organized 132-page manual that includes a quick start and tutorial section. The installation procedure is a simple batch file that copies files to your hard disk.

Vmos/3 provides several status screens that let you see and understand what is happening in the system. The main system selection menu displays the status of each task in the system—for example, executing, waiting for keyboard input, performing file I/O—and a bar graph of how much CPU time has been given to the task.

VMOS/3 comes with a single, well-organized 132-page manual that includes a quick start and tutorial section. The installation procedure is a simple batch file that copies files to your hard disk. It does not make any changes to your CONFIG.SYS or AUTOEXEC.BAT files. You are referred to the manual and a READ.ME file for the changes you must make to these files.

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CRASH PREVENTION

Other than *VM/386*, *Vmos/3* is the only environment reviewed here that prevented each application from crashing other applications or the system. If an application crashes, all you have to do is reboot that session by pressing the Ctrl-Alt-Del key combination.

The sharing of the hard disk between applications is the main cause of system failure. If the application had entered DOS before it crashed or when you pressed Ctrl-Alt-Del, there is a good chance that the entire system will be hung, as no other part of the system will be allowed to access the file system.

Pressing the hotkey with *Vmos/3* from an application screen moves you to the main menu. The selections available are displayed on the bottom line with an explanation in the lower portion (purple). The system status is shown in the top portion of the screen, and the right side of the table has the name of the task.

As with *VM/386*, the keyboard may become confused until you press and release either the Ctrl, Shift, or Alt key to tell the session that the key has been released.

OVERHEAD PROBLEMS

VMOS/3 had the worst overall performance of the tested environments. As is the case with *VM/386*, the cost in performance is high in terms of the overhead that is required to provide application isolation. The other environment we tested that comes with demand paging, *Microsoft Windows*, was also a relatively poor performer.

Vmos/3 did well on our tests when there was significant disk activity in one session, and other activity (CPU test) in the other session. *Vmos/3* recognized when the disk task was waiting on disk I/O and gave the CPU to the other task. However, *VM/386* 's test results were better in these situations.

Vmos/3 allows you to specify the priority of each task in the system. However, these are absolute priorities, so if there's a higher priority task in the system, *Vmos/3*

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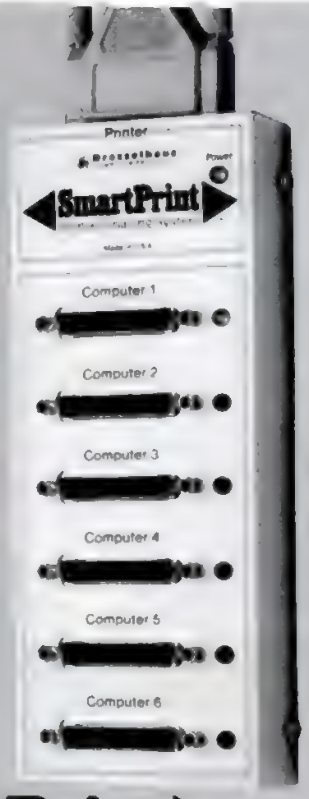

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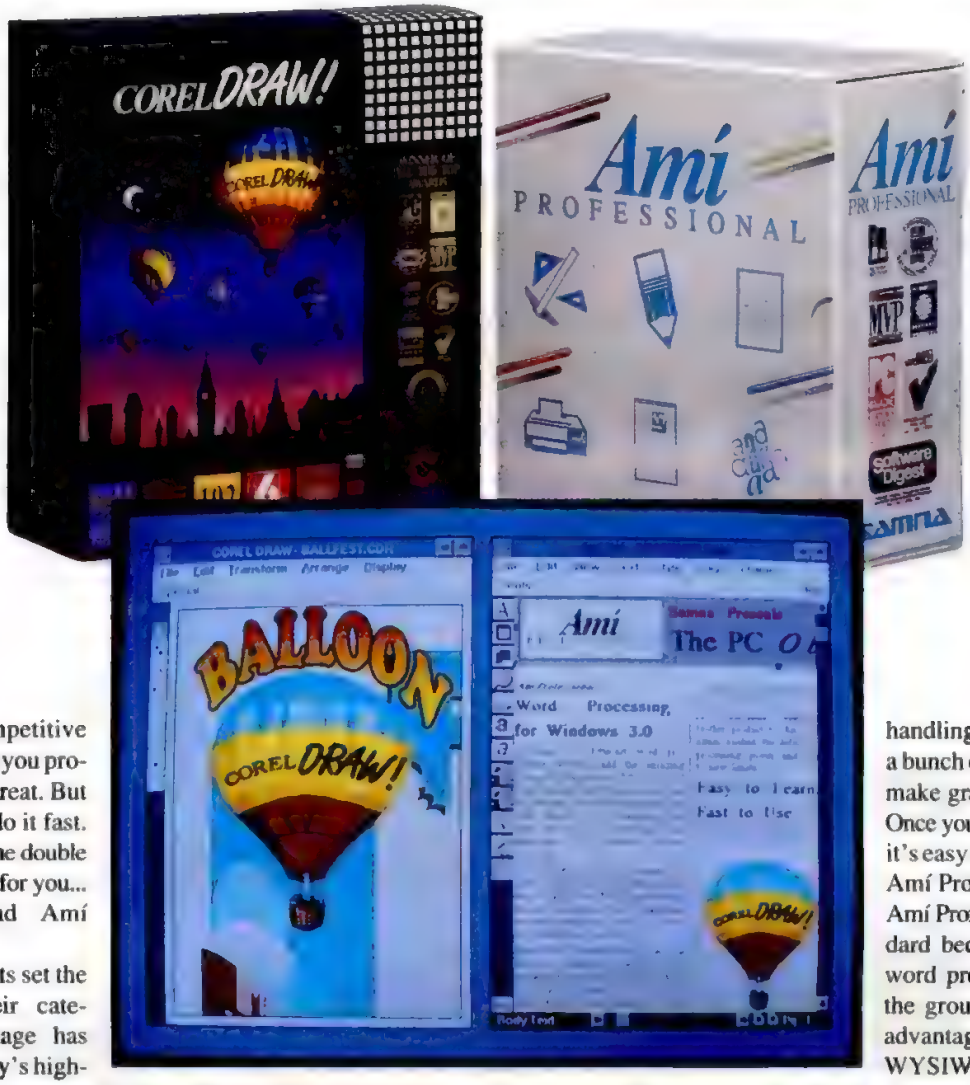

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will always run that task and never run the lower priority task. The foreground is given a priority of 29 (lower numbers mean higher priority) and the default priority is 30. This means that unless you take some action, the foreground will receive all of the CPU until it goes into a wait state.

This may be exactly what you want to occur. After all, you may be waiting for your word processor to reflect the change that you just typed and not really care how long the compiler takes. However, if you don't want this, the only choice you really have is equal sharing among the running tasks.

Vmos/3 offers demand paging and does a pretty good job preventing one DOS application from interfering with another or the system. It also has very informative status screens.

HARDWARE INCOMPATIBILITY

Vmos/3 does not support systems with an MCA bus, which really means that *Vmos/3* will not run on any IBM PS/2 system. *Vmos/3* must be invoked with a special /H option to work with bootable SCSI controllers. But, if the SCSI controller requires a special driver in your CONFIG.SYS, it currently cannot be used by *Vmos/3*. Over time these restrictions may be resolved. You may want to exercise caution for now.

Vmos/3 is the only one of the multitasking environments evaluated here that doesn't have a published API or support for environment-specific applications. However, this lack should be fulfilled in the near future.

Vmos/3 offers demand paging and does a pretty good job preventing one DOS application from interfering with another or the system. It has very informative status screens, and the *Vmos/3* user interface protects you from the underlying system complexity. Just a warning: you should beware of the system's hardware incompatibilities. ■

Brian Carr is a New York–based programmer and consultant, specializing in operating systems.

FACT FILE

***Vmos/3*, Version 1.0k2**
Microdyne Corp., P.O. Box 7213, 491 Oak Rd., Ocala, FL 32672; (904) 687-4633.
List Price: $199.
Requires: 1MB RAM, DOS 3.1 to 4.01
In Short: With demand paging and very good application isolation, *Vmos* has all the options necessary to completely configure your system. The *Vmos* user interface hides much of this complexity and has very informative status screens. However, *Vmos* does not support the full range of hardware or 386-specific applications.

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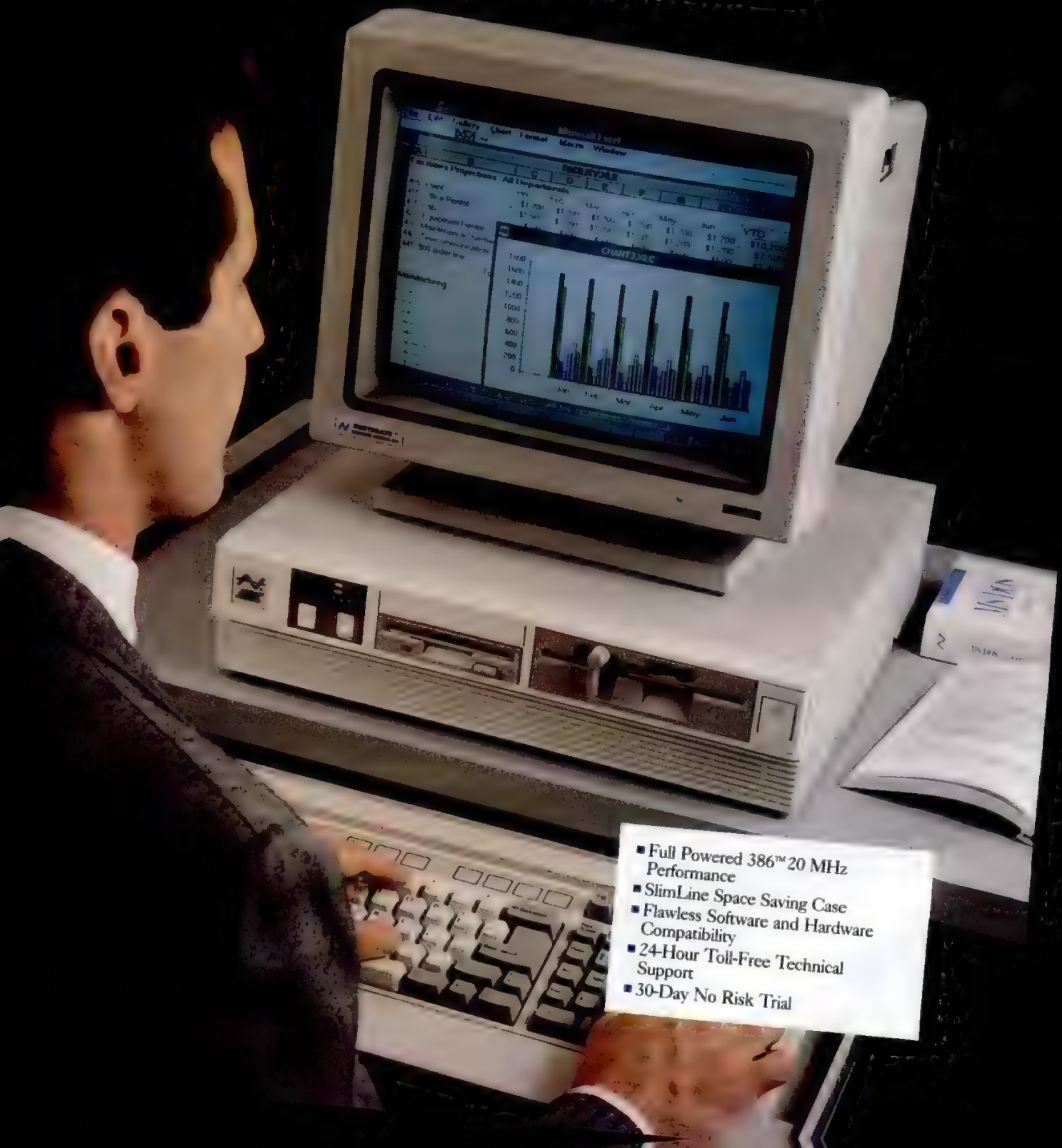

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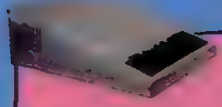

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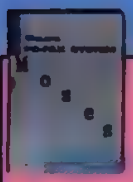

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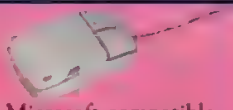

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BETWEEN BLACK AND WHITE

6 Gray Scale Editors

by Alfred Poor

Scanned gray-scale images require special tools to prepare them for use in desktop-published documents. *Gray F/X*, *Picture Publisher*, and four competitors let you adjust images for printing on laser printers and typesetters alike.

Continuous-tone images are one important element that PC desktop publishing programs have tended not to handle very well. True, affordable scanners that support 256 shades of gray, enough to create a faithful rendition of the original picture, are now readily available and provide an easy source of such images. And both *PageMaker* and *Ventura Publisher* allow you to paste these gray-scale image files directly into your documents.

Yet until recently, the final quality of the art has been dependent on the quality of the original scanned image. Desktop publishing programs offer no way to correct contrast or brightness levels or to compensate for degrees of exposure, much less to perform the kind of optimization that traditional printing technology takes for granted. Not surprisingly, for all but the most informal publications, people have had to rely on traditional paste-up procedures to add images to their desktop-published layouts.

PHOTOGRAPHS: THOM O'CONNOR

Well, now you can put away your X-Acto knives and waxers, your blue pencils and triangles, because you do not need to rely on these old-fashioned methods to get photographs into your publications. A new breed of gray-scale editors that can handle as many as 256 gray levels let you correct, retouch, and enhance such pictures after they come out of your scanner, making it possible to create an entire publication without ever leaving your mouse and keyboard.

MORE THAN PIXELS

At first thought, a special program to edit gray-scale images may seem unnecessary. After all, scanner files are simply bitmapped files, and many ordinary paint programs can handle gray-scale palettes. But if you do not have first-hand experience in trying to manipulate photographic images with a paint program, you might not appreciate just how difficult it can be.

Traditional paint programs are designed simply to let you place colors where you want them. Though you can achieve a limited mixing of shades using dither patterns and the airbrush tool, in general such programs are adapted for working with solid areas of single shades. But in a scanned photographic image, the different shades of gray are mixed throughout the image. Given the gradual progression from light areas to dark ones, it's extremely difficult to identify where one shade stops and another begins.

Working with an image like this requires more than just a pixel editor. It requires a program that can modify a whole range of shades across an entire section of a picture. And that's exactly what gray-scale editors do. Instead of viewing an image on a pixel-by-pixel basis, these programs look at the image as a series of mathematical values that can be transformed on the basis of complex algorithms to produce a desired effect.

This mathematical approach makes it possible to effect sweeping changes across the entire image at once. A gray-scale editor can let you adjust the overall brightness of the image in a single operation, for instance, or interactively change the values of individual parts of the gray map. You can use linearization and other histogram equalization techniques to adjust contrasts and bring out details, by changing the distribution of shades from light to dark. And you can use convolution techniques, which adjust values based on the values of adjacent pixels, to reduce or enlarge the size of an area over which a change takes place, which has the effect of sharpening or blurring the edges of an image. Such tools make it feasible to scan in an image, then adjust its appearance until it's suitable for publication.

WHAT'S IN AN EDITOR?

For this review, we chose to look at programs capable of performing these basic contrast and brightness adjustments on images with 256 shades of gray. We found six products (ranging in price from $99 to $595) that fit the bill and were shipping at the time of our review. *Picture Publisher* from Astral Development, *Gray F/X* from Xerox Imaging Systems, and *ImagEdit* from IBM's Applications Software Division are dedicated gray-scale editors, while *Image-In* from Image-In Inc. includes gray-scale editing functions as part of an all-purpose scanner package, and *PC Paintbrush IV Plus* from ZSoft incorporates them in a standard paint program. Finally, *ZIP Image Processor* from Catenary Systems provides a gray-scale editing solution specifically adapted for captured video images. (Another product, *ScanDo* from Hammerlabs, was not ready for release at the time of our evaluation.)

In addition to letting you adjust the contrast and brightness of the image, these programs let you perform many of the same tricks a photographer can do in a darkroom at the time a negative is enlarged to make a photographic print. With them, you can "burn in" the finer details in portions of the picture. You can overexpose a part of the image while letting another fade out. Most programs not only can make a focused picture a bit softer and fuzzier but can also sharpen the focus of a blurred image.

Unlike the photographer, however, you will also find a variety of new options and special effects at your disposal. Most programs let you easily cut one portion of an image and paste it into another, blending it seamlessly into the background; an architect, for instance, might use this capability to show the landscape with a proposed building in place. *Posterization* lets you reduce the number of gray scales used in an image, thus simplifying its values for an artistic effect much like a poster. And *pixellation* turns sections of an image into a mosaic of large gray squares—the same effect that the television news people use to obscure the faces of people being interviewed. The creative possibilities are endless.

PREPARING FOR THE PRESS

After you have edited your image, you will want to print it out. Though gray-scale images can be displayed on a screen in their true values, output devices such as laser printers and typesetters print only in black and white. In traditional printing, continuous-tone images are reproduced using the halftone process, in which the printed image is created by making a photographic plate of the original through a special dotted screen. If you look closely at a newspaper photograph, you can see how the image is transformed into dots of one size or another.

Typesetters can translate gray-scale images into faithful-looking halftones with aplomb. But laser printers can print only one size of dot, and desktop publishing programs tend to use grainy dither patterns that result in coarse and unnatural printed images. However, the gray-scale editors in this review can simulate halftones on your laser printer, approximating the different-sized dots by using carefully designed clumps of pixels. The results aren't as high in quality as you'd get from traditional printing processes (at 300 dots

EDITOR'S CHOICE

• **Gray F/X**

Among the gray-scale editors in this review, *Gray F/X* and *Picture Publisher* distinguish themselves by virtue of their sophisticated editing tools and halftoning features. Of the two, *Gray F/X* deserves our Editor's Choice thanks to its single-screen interface, which makes it easier to learn and use than *Picture Publisher*. With wide support for high-resolution displays, and good halftoning options, *Gray F/X* gives you everything you need to shepherd your gray-scale images from the scanner through to final output.

An honorable mention goes to *PC Paintbrush IV Plus*, which provides good, basic gray-scale editing functions for less than half of what the top packages cost. If you don't need the ultimate in features, it's a good choice.

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per inch, a laser printer can approximate a 53-line screen, somewhat below the 85-line screen used by newspapers, and well below the 133-line screen used by *PC Magazine*). But with the right options, they'll do well for many purposes.

Most packages simulate traditional line screens (in which the holes are lined up in even rows), and some can also simulate dot screens (in which the holes are distributed in a regular pattern) as well. You can also control the lines per inch and the angle of screen rotation, adjustments made in traditional halftones to give optimal results for different printing processes. The result is far more control and consequently better results than you could expect from your desktop publishing program alone.

HOW MANY SHADES?

by Rock Miller

As you probably know, your VGA card is capable of displaying a maximum of 256 colors on the screen at any one time. But the maximum number of gray levels that any of these gray-scale editors can show is 64. Why should this be? The answer lies in the design of the graphics card.

VGA cards produce color by combining shades of red, green, and blue in various proportions. The number of colors in the palette is limited by the card's digital-to-analog converter. The 18-bit DACs found in VGA and 8514/A cards allow 6 bits to be allocated to each color, which means 2^6 or 64 shades for each color. The color palette is thus composed of all combinations of 64 shades of blue times 64 shades of green times 64 shades of red, for a total of 262,144 colors. But since gray is produced by an equal combination of red, green and blue, the card can produce only the 64 shades or levels allowed of any single color.

Though the total palette of colors is quite large, the number of distinct colors that can be displayed on the screen is limited by the size of the index that selects the screen colors from the total palette. VGA cards have an 8-bit index, which means that it can display a maximum of 2^8 or 256 of these colors on the screen at once. ■

Unlike the repetitive pattern of a halftone screen, the silver crystals in a photograph are scattered across the surface of the image. To simulate this, a few of the products in this review offer randomized dither patterns that simulate levels of gray by density. These are far more sophisticated than ordinary dithering patterns and produce something that looks much more like a photograph.

When you're done, you can preserve these special effects by exporting the halftoned image to a file in a 1-bit (black-and-white) format compatible with your desktop publishing program. This also makes it possible to incorporate nicely tuned gray-scale images in publishing programs that don't support them. All of these programs can read and write standard TIFF files, the lingua franca of the PC desktop publishing world. Some can work with other popular formats such as .PCX, and most can export the gray-scale image in .EPS format as well. You can usually print the images directly from the gray-scale editor for proofing.

THE PLATFORM

So what kind of a system do you need to create and edit your own images? For the most part, a serious desktop publishing machine will be adequate for gray-scale editing, provided it has ample capacity. You'll need at least a speedy 286 or 386SX machine, or better yet a fast 386 with, of course, VGA graphics and plenty of memory. Above all, make sure you have lots of hard disk space. At 256 levels of gray, each pixel requires an entire byte to record the gray level. At an output of 300 dots per inch, this translates to more than half a megabyte for a 2-inch by 3-inch picture. Save a few versions of the same image, and you are talking about serious storage consumption.

Gray-scale editing is one place where video is important. Though many products work at 16 gray levels, the dithering required to display scanned images in this mode makes it quite difficult to see the effects of your changes on the screen. For practical purposes, you need to be able to see 64 gray levels on the screen, the maximum that your graphics adapter is likely to allow (see the sidebar "How Many Shades"). A standard VGA card with 256K of video RAM can display 64 shades of gray at 320 by 200 resolution, while Super VGA and 8514/A cards can do so at 640 by 480 resolution (the latter can do so at up to 1,024 by 768 resolution).

One thing you won't need is a special gray-scale monitor. While this does offer crisper images and smoother levels of gray than a standard color monitor, the difference is not enough to be significant. Furthermore, *Gray F/X* and *Picture Publisher* rely on color for special functions and menus, and these won't be visible on a gray-scale monitor.

The most meticulous desktop publishers will still prefer to strip in their images. But if you have been avoiding gray-scale images because they can't come up to minimal quality standards, it is time to take another look. You don't have to settle for just black and white.

Gray F/X

If the ideal gray-scale editor is a darkroom on a disk, *Gray F/X* from Xerox Imaging Systems ($495) comes closer to this goal than any other products in this review.

Gray F/X does not rely on *Microsoft Windows* for its user interface; instead, it uses a proprietary windowing system whose pull-down menus and movable toolboxes make it look like a cross between *GEM* and *Windows*. This design decision offers one great benefit; namely, it gives you a good gray-scale image on-screen at all times. The product supports all available VGA and 8514/A resolutions (including 320 by 200 by 64 shades of gray on standard VGA boards).

A few aspects of the interface take some getting used to; for instance, you have to click on a menu to get it to drop down. And you may find it takes a while to discover where all the controls and options are located. For example, the Zoom controls are contained in a menu that is triggered by clicking on an empty square at the upper-right-hand corner of the image edit window. Other tools like the Smudge and Blur tools are selected from a menu that drops out of the Frame, Brush, and Zoom toolkit. But you won't find them a problem once you figure them out.

SUPER ENHANCEMENTS

Since *Gray F/X* gives you excellent control over all aspects of your gray-scale images, the efforts you take to learn the program are amply rewarded. You can apply filter effects such as sharpening and despeckling to the full image or to a framed

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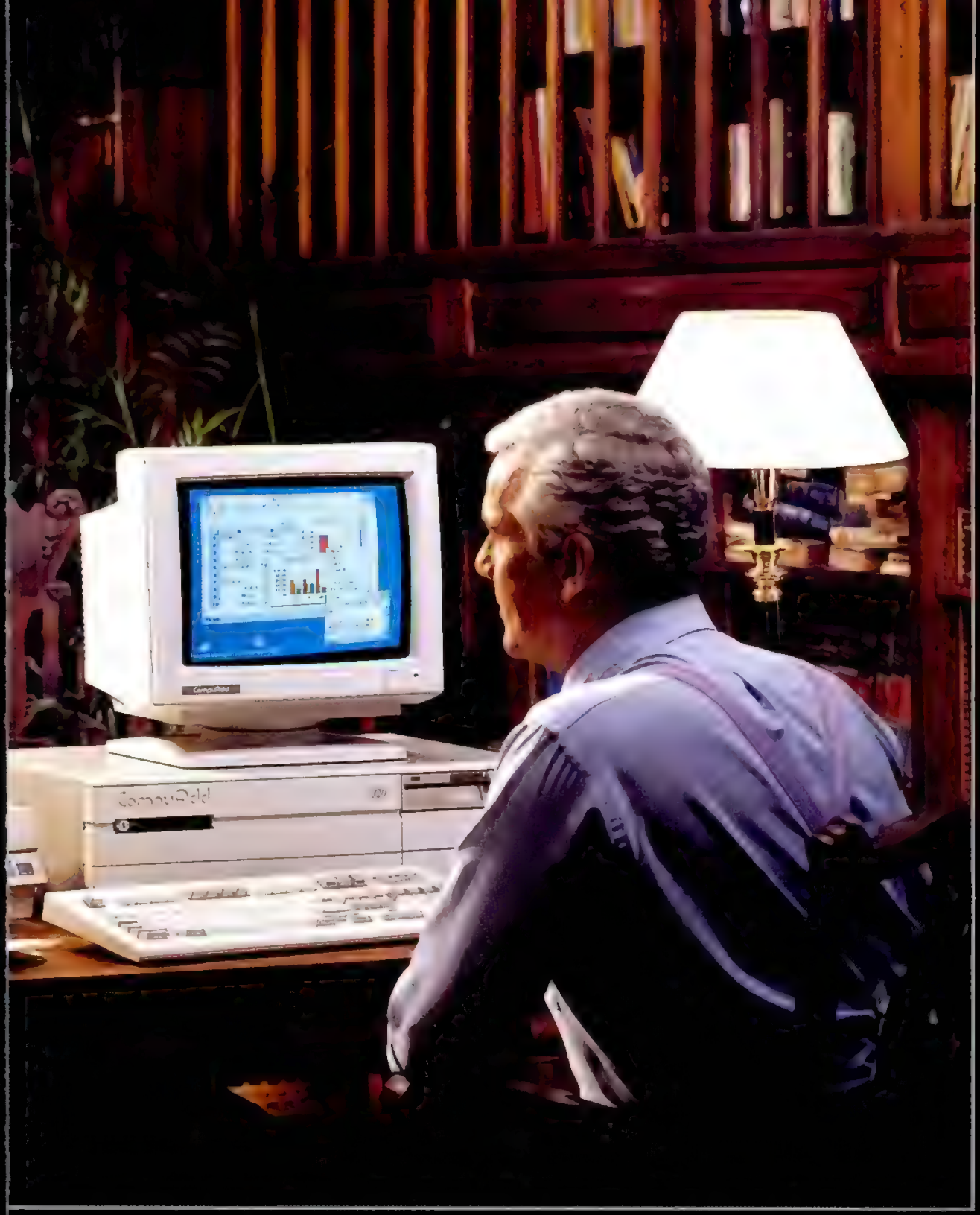

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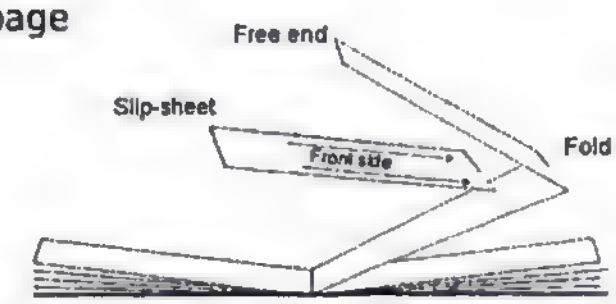

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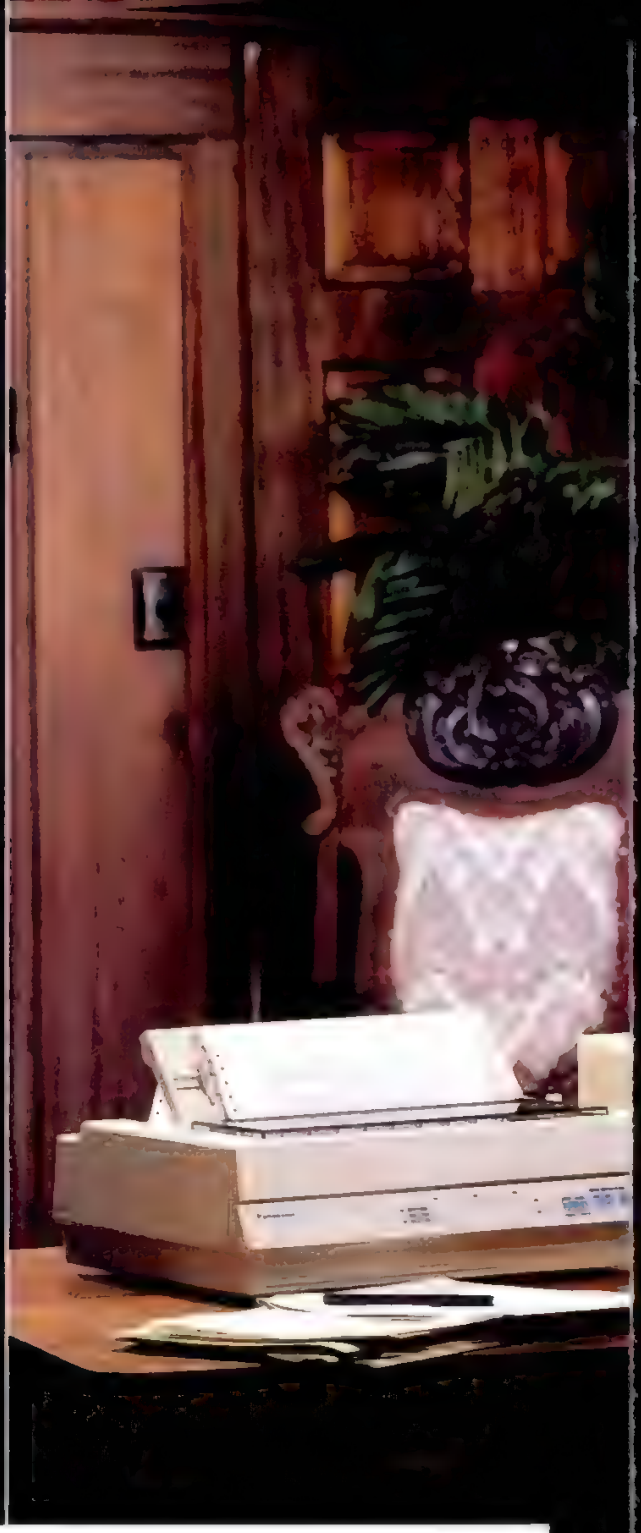

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A SAMPLING OF EFFECTS

Having a gray-scale editor means you're no longer limited to what you can get from your scanner. Products such as *Gray F/X* (whose output is shown here) offer brightness and contrast adjustments that let you compensate for too-dark scans. More-subtle changes to the gray map let you bring out details, sharpen edges, and deemphasize background shadows. Cloning and retouching tools make it possible to integrate and duplicate objects seamlessly within your images.

Gray-scale editors also let you simulate on your laser printer some of the screen effects offered by the traditional halftone process. The better packages simulate both dot screens and line screens, and let you adjust the density and angle of the simulated screen for optimal output quality. Most packages also offer randomized dither patterns that give the appearance of a photograph or mezzotint.

Image Enhancement

If your original scanned image is too dark, you can brighten all the gray values, giving you a lighter scan after the fact.

Contrast and brightness adjustments can be used sparingly for improving the definition and richness of an image, or exaggerated for a special effect, as shown here.

The ability to distinguish edges mathematically makes it possible to sharpen images as well as equalize their gray values. The details brought out by such procedures can be startling.

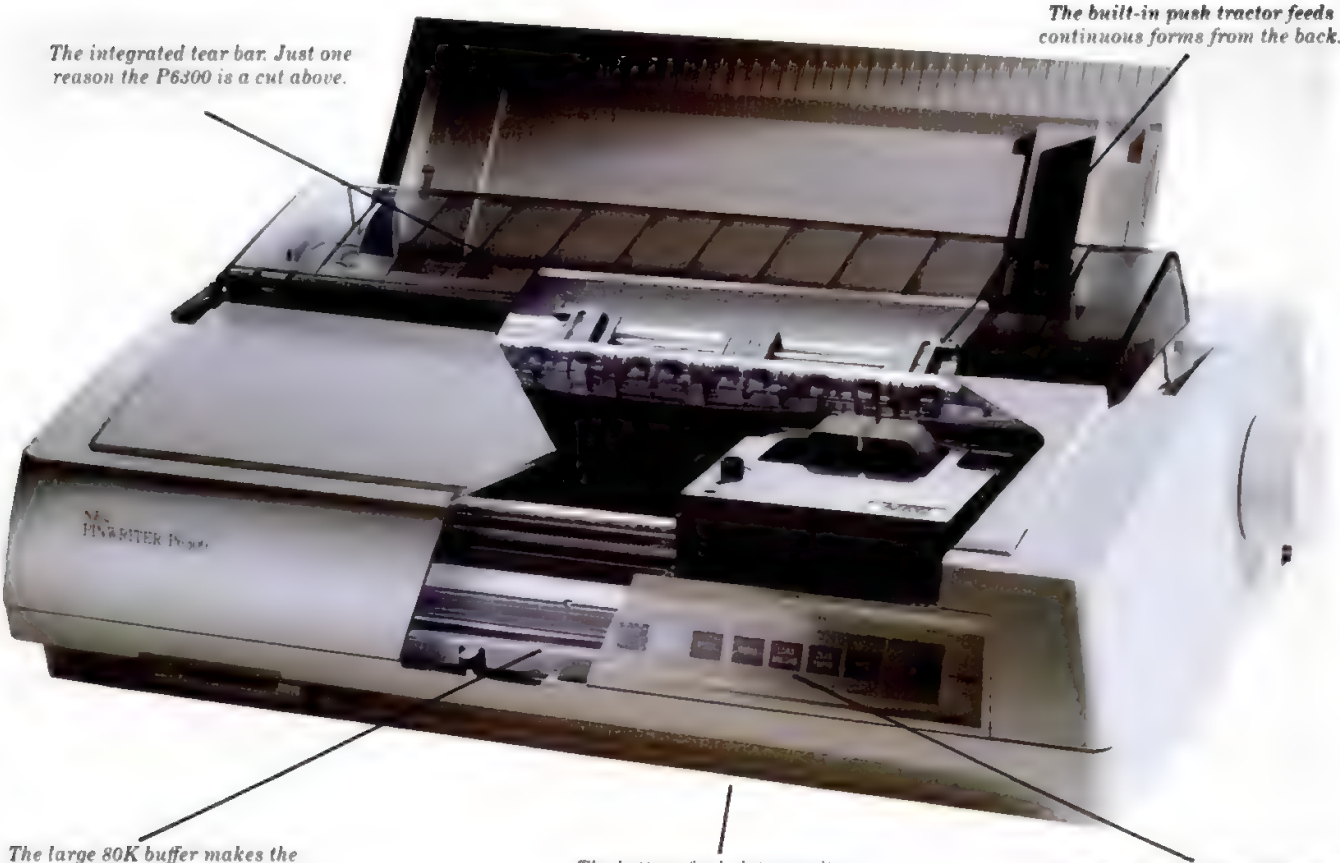
Halftoning Options

Gray F/X lets you trade resolution for gray scales in dot-screen halftones. The image on the left has 73 levels of gray at 35 lines per inch, while the one on the right has only 19 levels, but at 70 lines per inch.

A horizontal-line screen (left) can be overly obtrusive in some cases, depending on the image and the output resolution. An angled screen (right) sometimes gives a better appearance.

An error-diffusion pattern, in which dots are placed randomly with varying densities, can give a pleasing texture or a pointillist effect, depending on the settings.

Only the new NEC P6300 has the guts to outperform any dot-matrix printer in its class.



Only the Pinwriter* P6300 printer from NEC has the guts to deliver this much glory:

Bold, black print quality that makes a statement with every line. Color graphics* that turn not only heads, but opinion. Eight standard fonts that let you do more, more impressively. And a Quick Gothic™ font that gives you letter-quality output up to two-thirds faster than anything in its class. But the beauty of the P6300 (and its narrow-carriage brother, the P6200) extends beyond the printed page. Because they give you the ability to print on everything from 24-pound letterhead and envelopes, to continuous forms, labels, and card stock. Plus the ease to go from one to another, from one minute to the next.

It takes guts to say the Pinwriter P6300 is the best dot-matrix printer you can buy today.

It takes a lot less than you think to bask in its glory.

*Color kit sold separately.

NEC

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C&C

Gray F/X offers a wide range of gray-scale editing functions in an easy-to-use, integrated graphical interface. Here, the gray-scale map has been altered to increase highlights in the image.

section of the image. You can create an irregularly shaped frame almost as easily as you can create a square or circular frame. Once you define a frame, the rest of the image is covered with a light-gray screen effect; with a Super VGA adapter this appears as a red film, similar to what photographers use to mask off an area. You can invert the process just as easily, so that the filter takes effect only on the parts of the image outside the frame.

Gray F/X offers excellent control over the gray-scale map, letting you alter it in a variety of ways. Its histogram equalization procedures make it fairly easy to bring up details in faded pictures quickly. *Gray F/X* offers quarter-tone handles on the curves, and you can also manipulate the gray map across the entire range. All changes are interactive, and you see the effects right away.

Gray F/X lets you perform some unusual visual tricks. For instance, you can easily clone a portion of any image, making it easy to add a third World Trade Center tower to New York City's skyline, for instance. It also has some interesting special effects filters. One lets you simulate an embossed image, and another turns the image into a high-tech metallic picture—the results are striking.

Unlike the other programs, *Gray F/X* does not limit you to a single image at a time. You can load up to ten images (depending on how much memory you have) in separate windows, then cut and paste between them. The program can overflow images to your hard disk, but you'll be happier if you have plenty of memory to spare (*Gray F/X* supports both expanded and extended memory) because disk swapping with such large images slows performance to a crawl.

FREEDOM OF CHOICE

Gray F/X is no slouch when it comes to output, either. Though other programs offer more in the way of printer control features, *Gray F/X* gives you all the options you are ever likely to need. It lets you simulate dot or line halftone screens and gives you complete control over the screen angle. It also lets you select the number of simulated levels of gray to print; by using fewer grays, you can increase the effective lines per inch for the halftone screen. The results look very good when printed on a laser printer, and you can export them in TIFF, .PCX, .EPS, or .IMG (the black-and-white file format native to the *Ventura Publisher* environment).

Gray F/X is a high-powered program, and it takes some learning to master. But that's only to be expected with such a specialized tool. In return, it gives you an extensive degree of control over the appearances of your halftone images, and it offers excellent laser-printed output. It isn't perfect, but it's the best you'll find on the PC for now.

FACT FILE
EDITOR'S CHOICE

Gray F/X
Xerox Imaging Systems Inc., 535 Oakmead Pkwy., Sunnyvale, CA 94086; (800) 248-6500, (408) 245-7900.
List Price: $495.
Requires: IBM PC AT or compatible, 640K RAM (2MB recommended), hard disk, VGA graphics adapter, DOS 3.0 or later.
In Short: *Gray F/X* offers the best combination of ease of use, powerful features, and quality output. Its non-*Windows* interface takes some getting used to, but the effort is well worth it

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ImagEdit

It may seem like a well-kept secret, but IBM does publish application programs. *ImagEdit* ($495) is IBM Application Software Division's offering in the gray-scale editing field. But though it does offer the minimum functions necessary to serve as a gray-scale editor, it's missing

IBM's *ImagEdit* offers basic gray-scale editing features, such as adjusting the gray-scale map, and comes with a special driver to display gray-scale images under *Windows*. But it's not nearly as full-featured as its competitors.

FACT FILE

ImagEdit
IBM Corp., Applications Software Div., 101 Paragon Dr., Montvale, NJ 07645; (800) IBM-2468.
List Price: $570.
Requires: IBM PC AT or compatible, 640K RAM, hard disk, EGA or VGA graphics adapter, DOS 3.3 or later, *Microsoft Windows* 2.0 or later.
In Short: Despite its professional-level price, *ImagEdit* is lacking important gray-scale editing functions that are found in most of its competitors. It is too limited to be a serious contender.

CIRCLE 422 ON READER SERVICE CARD

many of the features of its competitors.

ImagEdit runs under *Windows* and uses a special VGA driver to display 16 shades of gray within that environment. Unfortunately this means you're tied to IBM's driver; when I tried running the program with the driver for the Video Seven 1024i card I was using, *Windows* lost control of the palette after I edited the gray-scale map for the image. You're better off using IBM's 8514/A adapter for this kind of work, as this will give you 64 shades of gray without any custom drivers.

FEATURE SHORTAGE

ImagEdit is more seriously handicapped by its shortage of features. In fact, it is essentially a paint program with a few extra functions thrown in. You can draw lines, add text, or cut, paste, and rotate images, and you can create shapes, erase areas, or crop the picture. But when it comes to gray-scale editing functions, you are essentially limited to the bare minimum. You can alter brightness and contrast, do histogram equalizations, and adjust the gray-scale map interactively, which is enough to retrieve lost detail and to improve the attractiveness of your scanned images.

ImagEdit is missing a lot of things. It does not give you such typical functions as edge sharpening or smoothing, image cloning (as distinct from cut-and-paste), or even an airbrush tool. It offers no filter effects, no smudge or blend tools, and no pattern matching. Though it has a shade-picker tool that lets you match gray shades precisely when you're retouching an image, picking a shade takes many more steps than it should.

The program is also weak in its output support. It offers only line screens in its halftoning options and doesn't let you rotate the screen. Of the industry-standard graphics formats, it supports only TIFF and .EPS, though it can also read and write files in IBM's proprietary IOCA format used for transferring image data to mainframes.

In the final analysis, *ImagEdit* comes across as a pale gray image, falling far short of the mark set by its competitors. Other programs at about the same price offer far more in the way of gray-scale editing functions and are a good deal easier to use.

Image-In

Image-In comes from Switzerland, and like the famous pocket knife from the same country, it can be used for an endless variety of tasks. Though the program's list price of $498 isn't particularly low, it

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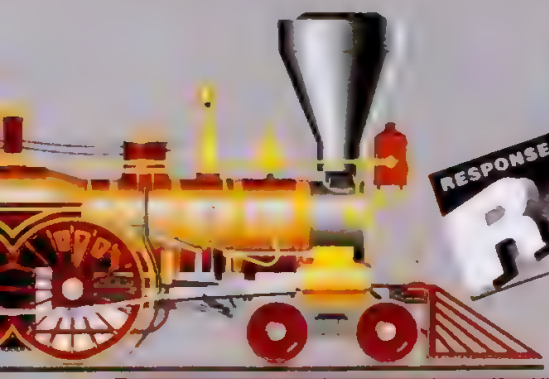
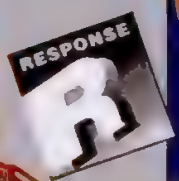
Windows 3.0 and OS/2 versions available!





COREL

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offers far more than just gray-scale editing. In a single integrated *Windows* program, you get full-featured scanning, paint, gray-scale editing, and bitmap-to-vector conversion facilities, plus optical character recognition. It is truly the Swiss Army knife of scanner software.

Starting with its latest release, *Image-In* runs under *Windows* 3.0 as well as under earlier versions (the package automatically identifies which version of *Windows* you're using and adjusts accordingly). Most of the functions are the same in both versions, but there are a few exceptions. For example, the eight-color limitation of *Windows* 2.0 required the inclusion of a gray-scale preview function in that version that is not needed in the *Windows* 3.0 version. This is one instance where standard VGA isn't enough; you'll need a Super VGA or 8514/A card to display more than four shades of gray on the screen without dithering.

SOLID TOOLS

Image-In's user interface puts the *Windows* pull-down menus to good use, with functional and intuitive choices. Most of its editing steps are automatic, and the results can be viewed immediately in real time. You can easily define the area within which any effect is to take place, thus limiting the portion of the image to be changed. You can open only one image in the program at a time, but you can run multiple instances and cut and paste between the windows.

Image-In's image enhancement features are quite solid. The gray-map editing options, for instance, not only let you change brightness and contrast and perform a histogram equalization, but also let you perform dynamic and log transformations of the gray map histogram, or posterize the image to limit the number of gray scales used. Similarly, the Filter menu offers extras in addition to the typical edge enhancement and smoothing functions. A Snow filter adds a fine pattern of random light and dark dots to the image for an interesting effect, while the Snowplow filter works the opposite, removing random dots from the image to yield smoother areas of different tones.

The program's paint features are equally strong. It has a shade picker that lets you copy one shade to another area. This is useful for some touch-up operations, but for large areas you need to maintain the random patterns of the surrounding area, such as a background or clothing fabric. Sophisticated cut-and-paste features come in handy here; they allow you to control the degree of transparency of the pasted block so that the original can show through a bit, making

FACT FILE

Image-In
Image-In Inc., 406 East 79th St., Minneapolis, MN 55420; (800) 345-3540, (612) 888-3633.
List Price: $498.
Requires: IBM PC AT or compatible, 640K RAM (1MB for *Windows* 3.0 version), hard disk, EGA or VGA graphics adapter, DOS 3.1 or later, *Microsoft Windows* 2.*x* or 3.0.
In Short: *Image-In* offers OCR and file conversion as well as gray-scale editing, making it an attractive value if you're looking for all-in-one scanner software. It falls a bit short of the competition on some features, though, so it might not be your choice if gray-scale editing is all you need.

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Image-In uses a dithered display under *Windows*, but you can still see the effects of your editing changes right away. Simple sliders let you alter the gray map (here, by using the Log function).

the effect a little smoother. But a dedicated cloning function would be better still.

ATTRACTIVE OUTPUT

Image-In offers an interesting effect on the printout side of its features. Besides having some of the most extensive controls for dot- and line-screen effects, it also includes an "optimized pattern" that simulates the random pattern of silver crystals in a photographic image. The result is a bit grainy and not well suited to images with many sharp edges, but for portraits it's excellent compared with dot-screen options. The program supports .PCX, .EPS, and *GEM* .IMG files in addition to TIFF.

I did run into some disconcerting problems. A bug in the *Windows* 3.0 version cancels changes to the gray map if you choose the Display option to update the screen. A company representative verified that the problem existed but added that a revised version that solved the problem was ready to ship. I also ran into some incompatibilities with third-party video drivers under *Windows* 2.1; the program lost the display on returning from the gray-scale preview screen.

Despite these unfortunate bugs, *Image-In* is in the main a strong program that offers exceptional functionality for the price. If you are looking for one program to do it all it can be a very good choice. But competitors offer more in the way of gray-scale editing functions. So if that's the core of the work you plan to do, you may prefer to go with another product in this roundup.

PC Paintbrush IV Plus

Gray-scale editing programs are fundamentally different from paint programs. So what is one of the best-known paint programs doing in this review? The answer is that ZSoft Corp.'s *PC Paintbrush IV Plus* goes far beyond the traditional bounds of its class. It drives scanners, manipulates gray-scale images, and more—all for the relatively low price of $199.

PC Paintbrush IV Plus offers a familar interface, with pull-down menus across the top line, a toolbox on the left, and palette options across the bottom. Here you have all the traditional paint tools at your disposal, including shapes, lines, airbrush, fill, and fat-bit editing. In addition, it offers tools to make global adjustments to gray-scale images, including the standard brightness, contrast, and gray-scale map equalization options, plus filters that can sharpen, blend, or remove spots from the image. It even offers a "mosaic" option that pixellates the image, transforming it into larger gray squares.

The program offers additional effects that you can paint directly on the image. These allow you to retouch portions of a picture relatively quickly with good results. You can add highlights and shadows with the brightness command, which changes the relative shade of the affected areas. You can also adjust the contrast of an area, and blend and smudge commands help you to smooth rough areas in the image.

All of this takes place on a true gray-scale representation of the image, not a dithered facsimile. *PC Paintbrush IV Plus* supports a very wide range of display adapters at various resolutions, with up to 256 shades of gray.

DOWN TO BASICS

The painting effects are quite easy to use; you just select them and then go to work directly on the image. The filters are a bit trickier, since you must first define an area in which they will take effect. If you need to change only a small portion of the image (for example, using the Sharpen option to bring up the detail in a specific area), you can do so relatively easily. Often, though, you'll want the filter effect to modify the entire image, and this requires you to go to a separate Filter entry on the Scan menu. This works, but it can be cumbersome; the program would be

PC Paintbrush IV Plus displays the image in a full range of gray scales and lets you see the effects of your changes as they happen. The Zoom Out mode lets you see the image on a larger scale.

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GRAY-SCALE EDITORS: SUMMARY OF FEATURES

Prices listed in ascending price order

	ZIP Image Processing	PC Paintbrush IV Plus	☑ Gray F/X	Image-In	ImagEdit	Picture Publisher
List price	$79	$199	$495	$498	$570	$595
IMAGE ENHANCEMENT						
Contrast adjustment	■	■	■	■	■	■
Brightness adjustment	■	■	■	■	■	■
Convolution	■	❑	■	■	❑	■
Histogram equalization	■	■	■	■	■	❑
Linearization	■	❑	■	■	❑	■
Pixellation	■	■	■	❑	❑	■
Blend	■	■	■	■	❑	■
Sharpen	■	■	■	■	❑	■
Clone	❑	❑	■	■	❑	■
Protect shades	❑	❑	❑	■	❑	■
Alter gray map interactively	❑	❑	■	■	■	■
Preview before storing	■	❑	■	■	❑	■
IMAGE EDITING FUNCTIONS						
Draw	❑	■	■	■	■	■
Fill	❑	■	■	■	❑	■
Cut/copy/move	❑	■	■	■	■	■
Airbrush	❑	■	■	■	❑	■
Pixel (fat-bit) editing	❑	■	■	■	■	■
Undo last step	■	■	■	■	■	■
MEMORY MANAGEMENT						
Overflows image to disk	❑	■	■	■	■	■
Expanded memory support	❑	■	■	*Windows 2.x*	*Windows 2.x*	*Windows 2.x*
Extended memory support	❑	❑	■	*Windows 2.x* and 3.0	*Windows 2.x*	*Windows 2.x*
HALFTONE PATTERNS						
Patterns:						
Line screen	❑	❑	■	■	■	■
Dot screen	■	❑	■	■	■	■
Random	■	■	■	■	❑	■
Other dither patterns	■	■	❑	❑	❑	❑
Rotate halftone screens	❑	❑	■	■	❑	■
Options	N/A	N/A	45 degrees	–90 to 90 degrees	N/A	0 to 90 degrees
Halftone screen resolutions (lines per inch)	53	15 to 150	17 to 645	1 to 9,999	Limited only by output device	Limited only by output device
FILE AND PRINTER SUPPORT						
File formats (read/write):						
TIFF	■/■	■/■	■/■	■/■	■/■	■/■
Compressed TIFF	■/■	■/■	■/■	■/■	■/■	■/■
.PCX	■/■	■/■	■/■	■/■	❑/❑	❑/❑
.IMG	❑/❑	❑/❑	■/■	■/■	❑/❑	❑/❑
.EPS	❑/■	❑/❑	❑/■	❑/■	❑/■	❑/■
Printers supported:						
HP LaserJet	■	■	■	■	■	■
PostScript	❑	■	■	■	■	■
LaserMaster	❑	■	■	■	■	■
Intel Visual Edge	❑	■	■	■	■	■
DEVICE SUPPORT						
Graphics adapters:						
EGA (640 by 350 pixels, 16 shades)	■	■	❑	❑	❑	❑
VGA (640 by 480 pixels, 16 shades)	■	■	■	❑	■	❑
VGA (320 by 200 pixels, 64 shades)	■	■	■	❑	❑	■
VGA (640 by 480 pixels, 64 shades)	■	■	■	■	❑	❑
8514/A (1,024 by 768 pixels, 64 shades)	❑	■	■	■	■	❑
Gray-scale scanners:						
Canon	❑	■	■	■	■	■
Hewlett-Packard	❑	■	■	■	■	■
Microtek	❑	■	■	■	■	■
Panasonic	❑	■	■	■	❑	■
Ricoh	❑	■	■	■	❑	■
Video capture boards	■	■	❑	❑	■	■

☑ Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

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August 1990
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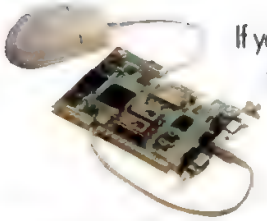

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CIRCLE 540 ON READER SERVICE CARD

FACT FILE

PC Paintbrush IV Plus
ZSoft Corp., 450 Franklin Rd., #100, Marietta, GA 30067; (404) 428-0008.
List Price: $199.
Requires: IBM PC XT, AT, or compatible; 640K RAM, hard disk, EGA or VGA graphics adapter, mouse, DOS 3.0 or later.
In Short: *PC Paintbrush IV Plus* falls short of the best of its competitors as a gray-scale editor, but it far exceeds expectations for a paint program. Its low list price will make it an attractive option for those who do not need all the features of the more expensive programs.

CIRCLE 426 ON READER SERVICE CARD

greatly improved by an option to allow the filters to affect either the whole picture or only a part.

PC Paintbrush IV Plus does lack some of the bells and whistles offered by the higher-end programs. You can't clone sections of the image, texture the image, or apply some special filter effects, for example. And though it supports a large number of scanners and printers and offers a good variety of dither patterns, its ability to simulate traditional halftone output is limited. However, its "diffused" and "enhanced" patterns—random dithers that emulate photographic images—are effective and attractive, especially on portraits. Naturally, it reads and writes files in .PCX format, as well as supporting TIFF and EPS.

All things considered, *PC Paintbrush IV Plus* is an attractive value. Though it's not the equivalent of a professional-level gray-scale editor, it does offer enough in the way of features to make it an effective tool, and its low price makes it an easy choice.

Picture Publisher

A photographic darkroom costs thousands of dollars to set up, takes up a great amount of space, and fills your home or office with funny smells. *Picture Publisher* from Astral Development Corp., on the other hand, lists for $595, fits on a single floppy disk, and fills your screen with handsome gray-scale images. This versatile program lets you do just about anything you can do in a darkroom, and more.

Picture Publisher runs under *Windows* 2.1 (a *Windows* 3.0 version is on the way), but only partially. Since the standard *Windows* VGA drivers are limited in the number of gray shades they can depict, *Picture Publisher* uses a *Windows* interface only to load the program and to set up certain defaults. For editing, it offers an enlarged gray-scale view of your picture in which you can can see 64 shades of gray at 320 by 200 resolution. This gives you enough shades to work in fine detail on a standard VGA adapter, but the program does not support the higher resolutions offered by its competitors on Super VGA and 8514/A adapters.

AMPLE TOOLBOX

The editing screen looks a little like a *Windows* screen. The menu commands, listed across the top, are supplemented by a toolbox that sits on the left edge of the screen and changes according to the function you select. For example, the View command gives you icons that let you select the zoom scale. The Edit menu gives you tools for cutting and copying, pasting, cropping, filling, and mirroring. And the Retouch menu offers sharpening, smoothing, lightening, darkening, and smearing tools. A palette bar on the right edge of the screen, which lets you select gray shades and do other tasks, completes the picture.

PC Paintbrush IV Plus offers enough features to make it an effective tool.

Unfortunately, the icons in the toolbox are not labeled, so it's not at all clear at first what functions they represent. Also, you may find it difficult to remember which command gives you the specific tool you want. You'll find the Blend tool, for example, under the Edit menu, but the Smear tool is under the Retouch menu. Astral does include an 8-page quick reference card that makes navigation easier, and with a little practice, you quickly learn to recognize the icons for your favorite operations. But more on-screen assistance would be preferable.

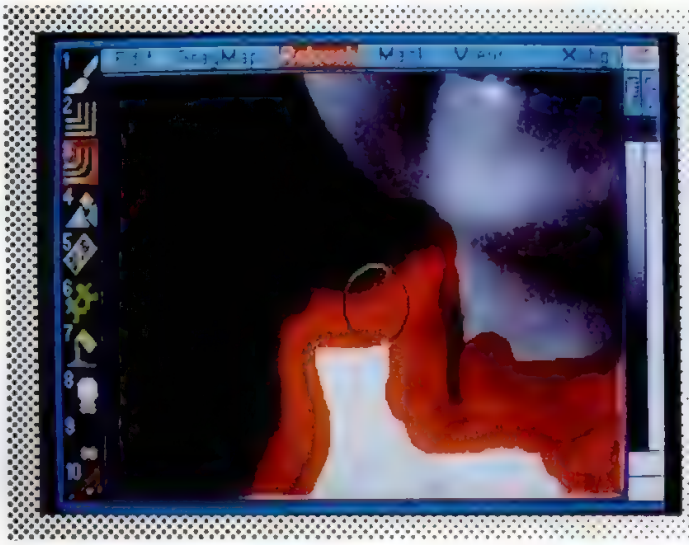
EASY EDITING

In many ways, using *Picture Publisher* is more natural than using most of the other

FACT FILE

Picture Publisher
Astral Development Corp., Londonderry Square, #12, Londonderry, NH 03053; (603) 432-6800.
List Price: $595.
Requires: IBM PC AT or compatible, 640K RAM, hard disk, EGA or VGA graphics adapter, DOS 3.0 or later, *Microsoft Windows* 2.03 or later.
In Short: Though *Picture Publisher* is a little obtuse and clumsy to use in spots, it gives you a wide variety of tools and effects that add up to a powerful gray-scale editing package.

CIRCLE 421 ON READER SERVICE CARD

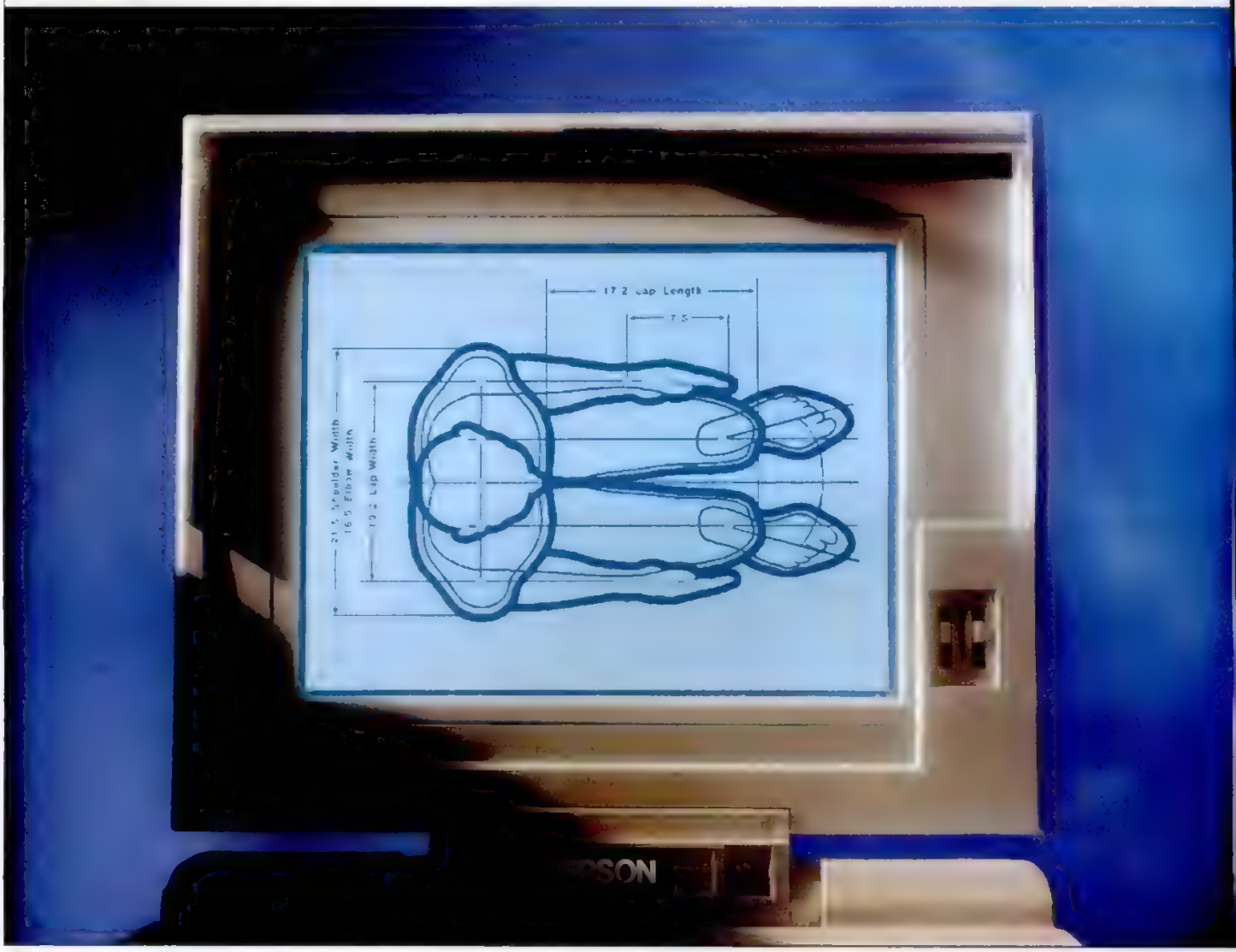


Though *Picture Publisher* is a *Windows* program, most of its detailed editing functions take place on a custom display that can show a full 64 gray levels. A red film, similar to that used by photographers, masks off the portion of the image you've selected for operations.

A laptop designed

that while your

your lap will stay p



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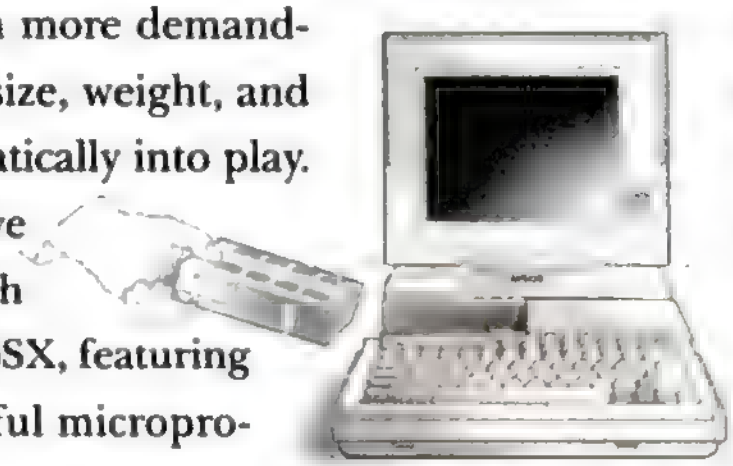

Epson's unique, removable hard drive: key component of the most flexible laptop ever made.

Epson's Datasafe hard drive can be removed, making it easy to transport, or store separately for added security. With an optional* drive port, the hard drive can plug directly into a desktop computer. It offers a choice of 20 MB or 40 MB capacity, and a shock indicator that alerts the user to the occasional hard knock.

The modular design of Epson's entire laptop series suggests a new standard for customized performance. The user can easily install or remove options such as a modem, extended RAM, external keyboard, or 2/3 length industry standard card. The VGA screen can also be removed or left in place when using an external monitor.

The Epson laptop indicates its own vital signs—battery life, speed, and disk drive in use—on a unique LCD status bar, and even has the good sense to turn off its own screen and hard drive when not in use.

The LT 386SX offers a degree of speed, power and flexibility once limited to desktop computers. In fact, there is one feature of this remarkably engineered bit of technology that a desktop can only envy. Its size.

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packages we reviewed. In order to sharpen or blur an edge, for example, you paint the area of interest using the mouse. The operation puts down a red film over the image, reminiscent of the masking film used in traditional printing processes. You can tune the brightness and contrast adjustments to the gray-scale map simply by moving the mouse up and down and left and right; the changes take effect immediately on the screen. The program does not offer automatic histogram equalization, however, though the vendor claims that its gamma-corrected scanner and printer drivers eliminate much of the need for this.

Picture Publisher does not offer automatic histogram equalization, though the vendor claims its gamma-corrected scanner drivers eliminate much of the need for this.

Picture Publisher offers some handy extras in addition to its standard effects. A Clone function lets you copy one portion of the image to another location simply by painting over the parts you want to copy. A similar function, Texture, lets you apply an uneven pattern to an area, an indispensable tool for recreating backgrounds or fabrics in an image.

A LITTLE AWKWARD

On the other hand, some parts of the program are a genuine pain to use. For example, in order to change the size and shape of your paintbrush, you must leave the gray-scale editing screen and return to the *Windows* screen. Since you often want to do this when you change effects, this design often imposes the considerable delay and inconvenience of switching modes and saving lengthy files. Similarly, though *Picture Publisher* offers filter effects that transform the entire image, these are available only on the *Windows* screen—you cannot access them in the gray-scale edit screens or see the results without again switching modes.

Picture Publisher does offer good support in its output options. It lets you control the angle of the simulated halftone screen with either dot or line screens (though not on a LaserJet), at resolutions as fine as your typesetter can handle. It also offers a random dither pattern that makes for attractive photographic-style prints on a laser printer. If you want to export your images, you can select between TIFF and .EPS formats. The program works with many popular scanners and offers direct support for a number of video image capture boards as well.

Despite its quirks, *Picture Publisher* is a strong contender, giving you excellent control and a wide range of options for editing gray-scale images. It is well worth your consideration.

ZIP Image Processing

ZIP Image Processing from Catenary Systems is in a class of its own. Most gray-scale editors are designed for editing images produced by scanners; they handle captured video images only through TIFF or other standard file formats. But the $79 *ZIP* is designed to work exclusively with captured video images, and it accepts direct input from a variety of frame-capture boards.

Unfortunately, this goal is responsible for *ZIP*'s severe limitation on image size. Composite video images tend to have relatively low resolution and so take up less space than scanned images. Unlike all the other packages, *ZIP* cannot overflow an image to disk, nor does it support expanded or extended memory. Our TIFF test image proved far too big for *ZIP* to handle; the program read in the top left-hand corner of the image but lost the rest.

ZIP does not rely on a mouse-based interface; its commands and menus are strictly character-based. As a result, the interface seems to be a bit old-fashioned at first. But you can execute keyboard commands quickly once you've learned your way around.

The program offers a complete range of filter effects, including contrast and brightness adjustments, gray-scale equalization, blending, sharpening, and edge detection. But these enhancements apply only to the full image; the program offers no masking or touch-up tools that would allow you to make detailed modifications.

LIMITED USE

One unusual feature is the program's three separate image buffers: the first holds the image to be modified, the second is a holding buffer, and the third receives the modified image. This design lets you create a variety of double-exposure effects by combining the first and second buffers in a number of ways. You can even merge the two images in such a way that one appears to be in front of the other—a technique that lets you quickly paste one image over another without painstakingly cutting the edge.

ZIP Image Processing can hold three copies of an image in memory at once, which is useful for comparing effects. In this example, the image at the lower left is the original, the image at the upper left is sharpened through the use of a filter, and the one on the right has been pixellated.

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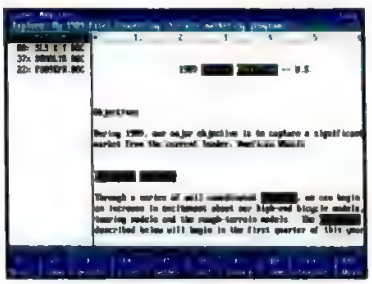

Magellan lets you find a file in seconds, even when you can't remember its name.

Magellan simplifies all of the other utility functions you use most, too. Copy, Delete, Move, Sort, Back-up or Rename files, groups of files, or entire directory branches in the Tree mode, with one keystroke. And Undelete erased files just as easily. Even view a deleted file before you decide to restore it.

Magellan also lets you save disk space by compressing data files up to 50%, with the built-in PKzip™ file compressor. And view compressed files without expanding them.

And since Magellan is customizable, you can turn any of its functions on and off, or even build custom menus.

All of which is why *PC Magazine* said, "Magellan could very well be the finest utility ever written for the PC." And why every major computing magazine has given it practically every award they have.

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FACT FILE

ZIP Image Processing
Catenary Systems,
470 Belleview, St.
Louis, MO 63119;
(314) 962-7833.
List Price: $79.
Requires: IBM XT, AT, or compatible; 400K RAM, EGA or VGA graphics adapter, DOS 2.0 or later.
In Short: Designed to work with captured video images, *ZIP*'s maximum file size is too small for most scanned images. Though its filters and effects are fast and functional, it lacks paint and retouching facilities.

CIRCLE 425 ON READER SERVICE CARD

ZIP is limited in terms of output, though it does offer a dot-screen halftone, a classic ordered dither, and a randomized pattern for laser output. However, it has only limited control over resolution and none at all over the halftone screen angle. Since the program does support .PCX, TIFF, and .EPS formats, you shouldn't have any trouble bringing your images into a desktop publishing program.

Catenary Systems offers a number of add-on products that work in conjunction with *ZIP*. A utility pack comes with a range of file-conversion programs and a slide show package; it also includes programs to convert text screens to graphics images, rotate or reverse images, and convert images to a Lotus worksheet format so that you can directly manipulate the numeric gray values for each pixel. Catenary Systems also offers a Colorkit utility that can be used to make color separations with a black-and-white video digitizer, which comes complete with colored plastic filters to place over the camera lens.

The least costly of the packages, *ZIP* is reasonably fast and powerful within its limitations. But its complete lack of paint tools and its inability to perform modifications on part of an image may be insurmountable stumbling blocks for many users, even for editing captured video images. Others are better all-around choices. ■

Alfred Poor *is an industry analyst with a special interest in desktop publishing–related topics, from page printers to imaging software. Based in Perkasie, Pennsylvania, he is a contributing editor of* PC Magazine.

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Vice President of Marketing
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QIC 150 Tape Drives: The Rising Star for Backup

For backing up both standalone PCs and small networks, DC 6000 quarter-inch cartridge tape drives continue to offer a cost-effective way to protect your data.

by M. David Stone

Let's face it; backing up data on a hard disk has to be the least interesting thing you can do with a computer. But it's also one of the most important. Backing up has much in common with that old pilots' saw about brakes on an airplane: You may rarely use them, but when you need them, you really need them.

A case in point: In a too-perfect coincidence, the day I started writing this article, I lost my hard disk. The system simply froze when it should have loaded a file. And when I rebooted, I got the chilling message: HDD Controller Failure. That was from an IDE hard disk, which includes the controller as part of the drive electronics.

On another day, this might have been a middling to serious disaster. But in preparing for this story, I had backed up my hard disk a half dozen times with an assortment of tape drives and software. The result: I only lost about an hour's work. The hero: a quarter-inch cartridge tape drive.

Alas, while deciding to back up is an easy decision to make, choosing how to back up is not. Basically, any device that you can hook up to a PC to record data can function as a backup peripheral. The possibilities include tape drives, Bernoulli cartridge systems, removable and non-removable hard disks, write-once optical disk drives, erasable-optical disk drives, floppy disk drives, and some oddball choices like VHS video recorders.

Even if you just consider tape drives—the most popular

OUR CONTRIBUTORS

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Ed Perratore is a frequent contributor to *PC Magazine*.
M. David Stone is a contributing editor of *PC Magazine*.

choice—you may still be surprised by the number of options. Capacities for today's tape drives range from 40MB per tape to 5GB; formats include quarter-inch DC 6000 cartridges and DC 2000 minicartridges, Teac's D/CAS cassettes, 4-mm. DAT cartridges, 8-mm. helical scan cartridges, half-inch 3480 cartridges, and half-inch 9-track reel-to-reel tape.

All this becomes harder to assimilate than it should be because the industry tends to play fast and loose with names and definitions. For example, 4-mm. DAT cartridges are actually 3.81 mm. They're sometimes referred to as 3.8-mm. DAT, 4-mm. DAT, 4 mm., or simply DAT cartridges.

Nor does it help that specifications are occasionally renamed. Not too long ago, the quarter-inch DC 6000 cartridges we're looking at in this story were called DC 600 cartridges. But don't look for a DC 6000 cartridge either. The actual name of the cartridge varies with the vendor. For example, 600-foot 150MB tape cartridges from 3M are labelled DC 6150, and 1,000-foot 250MB tapes are labelled DC 6250. Sony's 150MB tapes are called QD-6150. And the label on Maynard's tape says 600XTD/6150.

Still another source of confusion is that some terms do not mean what they seem to. For example, QIC is usually read as Quarter-Inch Cartridge, though it's also shorthand for the standards-setting organization Quarter-Inch Cartridge Drive Standards Inc. A QIC drive—meaning one that follows the QIC standards—uses a QIC cartridge, either from the DC 6000 series or the DC 2000 minicartridge series. However, a tape drive that uses a QIC quarter-inch cartridge may not necessarily follow the QIC standards for anything else. In other words, a quarter-inch tape drive is not always a QIC drive, even if it uses a QIC cartridge.

Last time *PC Magazine* reviewed tape backup, we focused on DC 2000 minicartridge systems (see "DC 2000 Tape Drives: Backup on a Personal Scale," December 26, 1989). These are low-end choices, with typical list prices ranging from about $400 to $1,350 for a complete package. The minicartridge, which measures roughly 3.25 inches by 2.5 inches by a little over half an inch high, currently offers capacities ranging from 40MB to 153MB per tape before data compression. The capacity varies depending on the recording scheme and the tape length. As with VHS video tapes, for example, thinner tape yields room for a longer tape, resulting in extended length cartridges.

While a 40MB to 153MB capacity per tape is still adequate for most standalone systems today, it's rapidly becoming outmoded. As the price of hard disks continues to fall, the number—and percentage—of higher-capacity disks continues to rise. Bob Katzive at DISK/TREND Inc., projects that fully 35 percent of hard disks sold in 1990 will be 60MB and above, with 100MB and beyond accounting for 21 percent of the total. By 1992, the percentages should grow to 43 percent for 60MB and above, and 23 percent for 100MB and higher.

Manufacturers of DC 2000 QIC drives have responded to rising hard disk capacity with a new recording scheme. QIC 380 will raise the maximum capacity of minicartridge drives to 380MB before data compression, but at this writing, there are no QIC 380 drives yet available. Expect to see them by early 1991.

In this overview, we chose to stay with DC 6000 QIC drives, because DC 6000 quarter-inch cartridges are the predominant choice for microcomputer backup. We focused on the QIC 150 specification, because, as Bernie Wu, Director of Marketing at Maynard Electronics says, it's the "rising star" among QIC tape drives.

The QIC 150 format isn't the best-selling QIC standard in unit quantity, according to Wu, but it is rapidly getting there. Part of the growing popularity for QIC 150 is that it has a foot planted firmly in each of two worlds. The maximum capacity of 150MB on a standard length cartridge and 250MB on an extended-length cartridge is appropriate for both high-capacity single-user systems and low-capacity networks.

REVIEW CRITERIA

To be included in this roundup, all systems had to use the QIC 150 recording format with DC 6000 cartridges, offer an unattended backup feature, and work under DOS 4.01. All 23 systems are complete packages, including external or internal tape drive, interface board, cables, and software. Typically, they pass data to the PC through a QIC 02 or QIC 36 interface card; some systems use SCSI boards. In all cases, we asked the vendor to supply us with the external version of its drive. Four vendors that offer products meeting these specifications were unable to send working units in time for review: Genoa, K.J. Warren, Plaindrome, and Valitek.

TOO MANY CHOICES

Of course, backing up with DC 6000 quarter-inch tape is just one of many options for tape backup, and tape itself is just one of many options for backing up. It's important, then, to have some perspective on QIC 150 in general before making a buying decision. Here is a quick look at some of the alternative technologies.

In the earliest computer systems, data storage was limited strictly to paper tape and punch cards. These paper memories were soon replaced by open-reel magnetic tape, as pictured in every movie you've ever seen that included a room-sized computer.

Although tape storage systems originally appeared in various formats, the industry quickly standardized on a half-inch tape with nine tracks for recording. For obvious reasons, the format is referred to as nine-track, half-inch, reel-to-reel, open-reel, or any combination of these terms. Typical reel sizes are 7 or 10.5 inches in diameter. Maximum capacity without data compression is 200MB to 300MB for a 10.5-inch tape.

When hard disks began to displace nine-track tape for primary storage, the industry found new roles for tape: as a backup medium and a data-exchange medium. Today, nine-track tape is the only medium that will let you exchange data between almost any two systems, including mainframes, minicomputers, and PCs. However, the large size of both the drive and the reels, and the high cost of these systems (prices start at roughly $3,000) make nine-track tape a poor choice for PCs if all you want is backup capability.

All the other physical variations on tape format use some type of cartridge or cassette. More important, the cartridges and drives are all significantly smaller than with half-inch reel-to-reel format, and most have a greater maximum capacity.

The half-inch 3480 cartridge, named

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Incredible proof of reincarnation

MAN LOSES HAIR WAITING FOR DOS

Anytown, USA—The unidentified victim was apparently among the millions of people who still think that DOS Backup and Copy commands are a safe and convenient way to back up their valuable hard disk data.

It is not known whether the shocking loss was a result of natural aging while DOS made the backup, or whether the victim pulled his hair out in frustration after discovering that a minor disk error had rendered his entire backup set useless.

According to reliable sources, the tragedy could have been averted if the man had been using **FASTBACK PLUS**, the world's fastest and most reliable backup software.

A special commission has been appointed to study ways in which the public can be made aware that **FASTBACK PLUS**' *Advanced Error Correction, easy-to-use menu, flexible file and directory selection, automated backup options* and other features allow even beginners to make fast, foolproof backups.

Public knowledge of these facts could ease the widespread stress and trauma that result from using DOS commands to back up hard disk data.

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after the IBM mainframe model with which it was first introduced, offers more than 200MB capacity. However, the 3480 cartridges are aimed squarely at the mainframe market, and secondarily at mid-range computers—prices start at $20,000.

More affordable is Teac's D/CAS cassette, which is similar to an audio cassette in size and shape. The D/CAS format is currently available in capacities of 60MB to 160MB; a 600MB format was recently announced. D/CAS drive units are generally less expensive than QIC packages with the same capacity. For example, Maynard sells an external 160MB D/CAS package for the AT bus for $1,895; its external QIC 150 tape drive package costs $2,195.

Although the D/CAS format is just as reliable as the more popular quarter-inch format and offers about the same throughput for backups, it has never gained more than a toehold in the marketplace. Part of the resistance to the format is that Teac is the sole source for the drive itself, which has some OEM vendors hesitant about committing to it. More important, QIC drive vendors were first to establish a set of industry-wide standards. And since both technologies fit the same niche, D/CAS has faced an uphill battle from the start.

Two relatively new alternatives for tape backup are 4-millimeter DAT and 8-mm. helical scan cartridges. Both of these offer large storage capacities, starting at 700MB for DAT and 2.3GB for 8 mm. Prices start at $2,750 for DAT drives and about twice that for 8-mm. drives. (For more information on these technologies, see the sidebar "The Helical Alternative.")

EDITOR'S CHOICE

- **Alliance QA150-EXAT**
- **Tallgrass FSO 150e**

For standalone PCs and for small networks, you will be able to do well with any one of the 23 internal and external QIC 150 cartridge tape drives that are reviewed here. But two of the units offer especially good feature sets, making them the Editor's Choice winners: The QA150-EXAT from Alliance Technology Inc. and the FSO 150e from Tallgrass Technologies.

The Tallgrass FSO 150e unit comes with proprietary software that is notable for its ease of use. It also works with the industry-standard *SY-TOS* and *Sytos Plus*, which means that it can share tapes with other drives. On PC Labs' performance tests, Tallgrass came in consistently faster than average. Like several of the other drives we reviewed here, Tallgrass includes support for QFA (Quick File Access), letting you quickly restore any individual file on a tape. Another nice feature is the FSO 150e's software data compression option, which none of the other products have. Network support is limited to Novell *NetWare 286* and *NetWare 386*, but if that's what you have, it's all that you need. All these features combined with Tallgrass' mid-range $1,795 price make it an exceptionally good value.

The Alliance Technology offering includes your choice of *SY-TOS* or *Sytos Plus*. What makes the product particularly interesting is the support for third-party software options specifically designed for network backup. Speed on PC Labs' tests was slower than average, but support for QFA is a bonus, as is the low list price of $1,395.

Honorable mentions go to the COREtape CT150/250E, the Everex Excel Stream 150, the Irwin 6451-E, and Maynard's MaynStream 150Q. CORE and Maynard were the two best performers on our tests, but, without QFA and support from *SY-TOS* or *Sytos Plus*, they fall shy of Editor's Choice. The Everex and Irwin units are supported by *SY-TOS* and *Sytos Plus* and they do have QFA, but at $1,899 and $1,975 respectively, they're not only slightly slower than Tallgrass, but also more expensive.

What of some of the other, well-known products? Colorado Memory Systems' QFA500 is the fastest—with its unique hardware data compression up and working—but it doesn't offer *SY-TOS* or *Sytos Plus* software. And, although Emerald Systems' RapidRecover 150 Model RAP150-9000 has the easiest proprietary software, it does have a few drawbacks: it doesn't work with *SY-TOS* and *Sytos Plus*, delivers only average speed, and is also somewhat expensive at $2,095.

RANDOM CHOICES

Tape is far from the only medium for backup. It's been the preferred form partly because it is reasonably convenient, but primarily because it's inexpensive on a cost-per-megabyte basis. Other choices for backup media include everything from floppy disks to state-of-the art magneto-optical disks. You can even use a second hard disk to mirror the data on your working disk.

These alternate choices all have one important advantage over any tape drive: because they are random access media, they can restore any file immediately, without wasting time searching through a tape. If you trash a file, you only have to insert the right floppy, optical disk, Bernoulli cartridge, hard disk cartridge, or WORM disk, and copy the backed-up file back to your hard disk.

All of these random access media also give you the choice of backing up and restoring with either the DOS copy command or a backup program such as *Fastback*, *Norton Backup*, or the backup module in *PC Tools*. Any of these programs—or even the DOS Backup and Restore utilities—will let you back up a large file that spans several floppy disks, for example.

Most backup programs, including *PC Tools*, *FastBack*, and *Norton Backup*, have a data compression option. Even if you assume a 2-to-1 data compression ratio, however, the price per megabyte for backup is far higher with any of these choices than with tape.

Using actual prices from a recent supply catalog, and ignoring the possibility of data compression, the price per megabyte for some typical choices are: $1.89/MB for a 20MB Bernoulli cartridge, $.90/MB for a high-density 5.25-inch disk, and $.42/MB for a 600MB rewritable optical disk. Compare these prices to $0.17/MB for a DC 6150 tape cartridge or $0.03/MB for a 4-mm. DAT cartridge and you begin to see why tape is so popular for backups.

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BACKING UP: Guide to Media Choices

by M. David Stone

Two obvious factors in choosing a backup technology are price and capacity. But these are related in less than obvious ways. For example, an 8-millimeter drive selling for $7,000 obviously costs more than a quarter-inch drive at $2,500. However, based on figures provided by Strategic Market Data, tape cartridges yield a price per megabyte of about 2 cents for the 8-mm. drive compared to roughly 13 cents for the quarter-inch drive. Clearly, if you buy enough tape cartridges, the less expensive drive eventually winds up costing more.

In general, you should pick a technology that meets your current needs and has plenty of room for growth. The rule of thumb when choosing a backup system is to pick a capacity at least as large as that of your current hard disk—if you can afford it. The rule of thumb in choosing a technology is to select one that allows a growth path for your likely future needs. A 40MB capacity per tape may be all you need now, but if the technology has a 380MB ceiling, and you plan to eventually move to a 600MB hard disk and tape drive, you'll have to change the technology as well as the drive, and you'll lose the ability to read your library of tapes. To help decide among the various technologies, here's a thumbnail sketch of the most popular choices, along with some vital statistics on each. All capacities are given before data compression and all prices are list prices.

VHS
VHS drives use VHS cartridges, with current capacities at 2.5GB to 5.4GB per $15 to $25 cartridge. This is a high-end choice, with prices of $5,000 to $40,000 for a complete package. Manufacturers include DataTape, Digi-Data, and Honeywell for the drives, and BASF, Fuji Photo, JVC, Kodak, Maxell, Sony, and TDK for the cartridges. VHS currently offers the largest capacity per cartridge. The key disadvantage is price. There are also several boards that will let you connect a Betamax or VHS format VCR to your computer, but these have capacities of about 400MB, with slow transfer times.

D/CAS Data Cassette
An entry-level technology with capacities starting at 20MB, the D/CAS format offers a maximum of 600MB per cartridge. All drives are manufactured by Teac. Maxell and Verbatim are the key manufacturers of the $35 cartridges. The advantage of D/CAS is that it overlaps the current capacities of both DC 2000 and DC 6000 formats, while often selling for less (list prices go from $1,300 to $3,300). The chief disadvantage is that it has never been a popular format, and may ultimately offer fewer choices for upgrades.

Quarter-inch Tape, DC 6000 Cartridge
The best-selling format for microcomputer backup, the DC 6000 offers a relatively low price with appropriate capacities for everything from entry-level hard disks to mid-size networks. Current capacities run from 60MB to 525MB per $35-$75 cartridge, and will be extended to 1.35GB in 1991. Drive packages range from about $1,000 to $4,000. Three manufacturers—Archive, Tandberg, and Wangtek—account for about 90 percent of the drive mechanisms. The cartridges are manufactured by 3M, Carlisle, Gigatek, and Sony. Choosing quarter-inch technology is wise if you expect to need more than entry-level capacity, without multigigabyte capability.

4-mm. Digital Audio Tape
DAT drives fill the gap between quarter-inch drives and 8 mm., with current capacities of 700MB to 2.3GB per $30 to $45 cartridge and prices of $2,500 to $6,000 per drive package. Media manufacturers include BASF, DIC Digital, Fuji Photo, JVC, Maxell, Sony, and TDK. Drive manufacturers include Archive, GigaTrend, Hewlett-Packard, Sony, WangDAT, and Wangtek. While 4-mm. drives will probably always lag behind the larger 8-mm. drives in capacity, their lower price makes them a better choice if you foresee your network backup needs leveling off at a few gigabytes per cartridge.

Removable Cartridge (Bernoulli)
Removable cartridges or hard disks, of which Iomega's Bernoulli cartridge is probably the best known example, have the same advantages as optical disks: nearly on-line speed for restoring files. They also have less capacity—10MB to 44MB per Bernoulli Cartridge—but are less expensive as well, at $1,299 to $2,599 per Iomega drive package and $83 to $140 per cartridge. These are logical if you need relatively small amounts of backed-up data in easily restorable format.

5.25-Inch Optical
Optical disks fall into two categories: WORM (Write-Once Read-Many) drives and Erasables. WORM drives, priced at $2,500 to $4,000, have a capacity of 600MB to 1GB per $100 to $200 disk. Erasable drives, priced at $4,500 to $7,000, offer capacities of 250MB to 650MB per $250 to $300 disk. Disk manufacturers overlap somewhat for the two technologies, with Maxell, Philips/Dupont Optical, and Pioneer making disks for both. Other manufacturers include Plasmon and TDK for WORM disks, and 3M, Dalcel, Hoechst, Kuraray, Mitsui, NEC, Ricoh, Seiko Epson, and Sony for erasable disks. Drive makers also overlap, with Hitachi, Pioneer, Panasonic, and Ricoh making both kinds of drives, while ISI, LMSI, Mitsubishi, and Optimem build WORM drives and Canon, Maxoptix, Sharp, and Sony manufacture erasables. The high price of disks makes both technologies expensive compared to tape drives, but since they're random access devices, both offer a nearly on-line speed for restoring files. Choose optical drives if you need large amounts of backed-up data in an easily restorable format. Choose WORM drives if you can't afford even the remote possibility of rewriting over the backup data.

PHOTOGRAPHS: THOM O'CONNOR

Floppy Disks
Floppy disks are slow, and, since capacities are 360K to 1.44MB per $1 to $2 disk, you'll need lots of floppies to back up even a small hard disk. Their only advantage is that they don't require any additional hardware investment. Key drive manufacturers include Teac, Toshiba, Panasonic, Sony, Mitsubishi, Y-E Data, Citizen, Chinon, and Alps Electric. Disk manufacturers include 3M, CAO, Verbatim, Fuji Photo, and Maxell. Choose floppy disk backup only if you have a small hard disk and the discipline to swap disks.

Quarter-Inch Tape, DC 2000 Minicartridge
An entry-level technology, the DC 2000 minicartridge offers capacities from 40MB to 150MB per $30-to-$40 cartridge, with 380MB scheduled for 1991. Leading DC 2000-drive manufacturers include Archive, Colorado Memory Systems, Irwin, Mountain, and Wangtek. The cartridge manufacturers are 3M, Carlisle, and Sony. List prices are $400 to $1,400 per system. These minicartridge drives should solve your backup problems if you stay with a standalone system and a low- to moderate-size hard disk.

8-mm. Helical Scan
This technology, with capacities of 2.5GB to 5GB per $40 cartridge, has the expected high-end price of $7,000 to $8,000 for a complete PC package. All drives are manufactured by Exabyte or by its one licensee. Media manufacturers include BASF, DIC Digital, Fuji Photo, Maxell, Sony, and TDK. For networks that need multigigabyte capacity, 8 mm. offers one of the largest capacities presently available with plenty of room for growth. This is the choice if you see your needs growing quickly with no end in sight.

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▣ Kemeny/Kurtz Math Series . *each* 45.

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Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

American Power ... 2 years
7108 APC Smart-UPS 400 ..... 339.
6811 360SX *(stand-by power source)* ... 255.
7107 450AT *(stand-by power source)* ... 339.
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7061 BOCARAM/XT 0K *(0-2 Meg, LIM 4.0)* 99.
7135 TophAT *(16-bit backfill 512K to 640K)* 99.
6998 I/O Board for AT ..... 59.
6999 I/O Board for Microchannel S/S/P . 109.
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7026 1024 VGA *(16 bit non-interlaced)* .. 149.
Bravo Communications
7400 2 Pos. Laser Compatible Switch Box 109.
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7345 Rollermouse *(Trackball) serial* 85. *bus* 99.
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7358 Command Center ..... 93.
Glass Filter Plus *(specify size)* .. ea. 65.

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6901 Switchboard ..... 175.

Epson ... 1 year
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7775 Equity LT-286e Laptop ..... 2297.
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Hayes ... 2 years
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7391 Ultra 9600 Modem ..... 899.

Hewlett-Packard ... 1 year
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6582 LaserJet IIP *(w/toner)* ..... 1069.

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6421 2400B MNP Internal Modem .... 199.
2352 2400B Internal Modem 2 *(for PS/2)* 249.
5119 2400 Baud External Modem ..... 179.
6420 2400EX MNP Modem ..... 229.
2346 Inboard 386/PC w/1 Meg *(w/free Ami)* 519.
4266 Above Board Plus 512k ..... 369.
4267 Above Board Plus I/O 512k ..... 399.
5336 Above Board Plus 8 2 Meg ..... 599.
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4272 Above Board 2 Plus 512k ..... 469.
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7768 C9 Mouse with Windows ..... 149.
5151 HiREZ Mouse *(C9)* ..... 85.
6029 Trackman *(Trackball) serial* 85. *bus* 89.
4297 ScanMan Plus *(hand scanner)* ... 185.

Micron Technology ... 2 years
6669 Intensify 2 Meg Expansion for HP LaserJet II *(upgradeable to 4 Meg)* 219.
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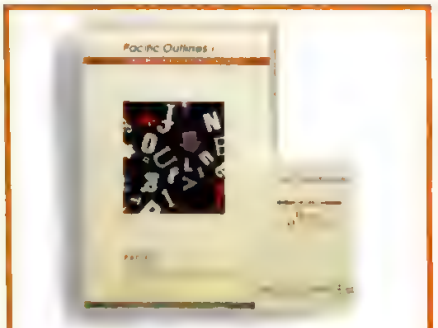

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7758 *3 Meg* ... 279. 7759 *4 Meg* ... 339.
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7158 Pacific Page *(PostScript Cartridge for LaserJet IIP/III)* ..... 379.
7632 Outlines I . 209. 7631 Outlines II . 209.
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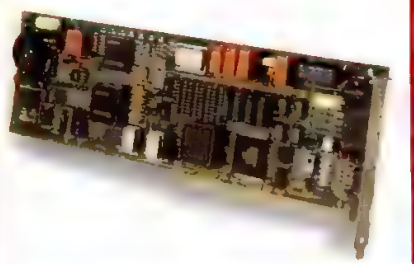
3100 1200 Baud External Modem *(mini)* . 77
3103 2400 Baud Internal Modem 135
3102 2400 Baud External Modem 179
5286 2400 Baud Int. MNP Modem *(Lev. 5)* 175
5285 2400 Baud Ext. MNP Modem *(Lev. 5)* 209
4542 2400 Baud Internal Modem for PS/2 . 229



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5828 TheComplete Communicator .... 559.
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5113 44 Meg Cartridge Tripak *(5¼")*... 249.
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2917 40-60 Meg Internal Tape Drive ... 299.
5502 83-152M Ext. Tape Drive..... 799.
5500 83-152M Int. Tape Drive ..... 629.
5190 DC2000 Pre-formatted Cartridges ea. 35.
Pacific Rim ... 1 year
5010 1.2 Meg External *(for PS/2's)*..... 215.
6602 1.44 External *(for PC/XT/AT)* ..... 239.
Plus Development ... 2 years
6425 Hardcard II 40 Meg *(19 ms)* ..... 599.
6424 Hardcard II 80 Meg *(19 ms)* ..... 699.
Seagate ... 1 year
2285 20 Meg Int. Hard Drive ST225 *(w/controller and cables, 65 ms)* .. 255.
2286 30 Meg Int. Hard Drive ST238R *(w/controller and cables, 65 ms)* . $269.
4554 40 Meg Int. HD ST251-1 (28 ms) .. 329.
TEAC ... 1 year
4951 720k Drive *(specify XT or AT, 3½")* . 75.
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4326 1.44 Meg Drive for AT *(includes Bastech software utilities, 3½" copy prot.)* . 109.

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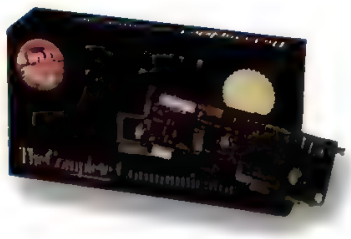
Maxell ... lifetime
2789 5¼" MD2-D 360k Disks *(Qty. 10)* .... 12.



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3292 5¼" DS/HD 1.2Mb Disks *(Qty. 10)* ... 19.
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6659 QD 2000 Tape Cartridge..... 19.

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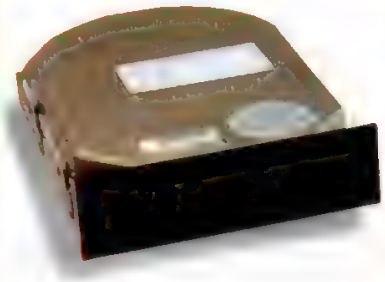

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may soon challenge tape on a cost-per-megabyte basis is some variation of an optical drive. At this writing, a 600MB rewritable optical disk sells for between $200 and $300. However, there is no inherent reason for the disk to be that expensive.

Assuming the optical drive manufacturers get together on a single standard, economies of scale will soon bring the price down. As a point of reference, a 600MB disk selling for $100 would have a cost per MB of $.17, essentially identical to the current cost per megabyte of a DC 6150 tape cartridge. And the optical disk would still have all the advantages of a random access device. Stay tuned for further developments on this one.

THE QIC STANDARD

As already mentioned, the quarter-inch cartridge has been the most popular choice for backup on microcomputers, at least up to now. The DC 2000 minicartridge formats include: QIC 40 (40MB capacity), QIC 80 (80MB and 120MB), QIC 100 (20MB and 40MB), QIC 128 (86MB and 128MB), and the new QIC 380 (380MB), which should be available by 1991.

THE HELICAL ALTERNATIVE: 4-mm. and 8-mm. Drives

by M. David Stone

If the 525MB-per-tape capacity of the QIC-525 recording format isn't enough, you could wait for 1.35GB-QIC drives due next year. Or you could consider two other technologies: 4-millimeter DAT (Digital Audio Tape) and 8-mm. helical scan drives.

Neither of these drive technologies is a low-cost solution. PC-based DAT packages range in price from about $4,000 to $5,500, and 8-mm. packages range roughly between $7,000 to $8,000. But if yours is a medium or large network, the price may seem small for the gain in storage capacity.

Both 4-mm. and 8-mm. drives use a helical recording scheme derived from VCRs and audio DAT systems; both provide plenty of storage. Drive packages in the 8-mm. size are based on Exabyte's EXB-8200 drive and offer you storage capacity of 2.5GB per cartridge. Exabyte, which introduced 8-mm. technology in 1987, has announced a new version of its drive that will record 5GB on a cartridge. That's about as much information as you could store on ten 525MB-QIC cartridges or 420 high-density 5.25-inch floppy disks. Packages based on the new EXB-8500 should be available by early 1991.

In 1989, 4-mm. drives came out of the gate offering an uncompressed storage capacity of 1.3GB per cartridge. A new extended-length tape, which should be available by the first quarter of 1991, will increase capacity to 2GB.

When you see the size of 4-mm. and 8-mm. cartridges and consider how much information they can hold, you're bound to find them impressive. Often described as credit card-sized, 4-mm. cartridges measure 0.4- by 2.9- by 2.1-inches (HWD), while 8-mm. cartridges are only a little larger, measuring 0.6- by 3.7- by 2.5-inches (HWD).

HELICAL SCAN RECORDING

The secret to cramming so much data into such small packages is helical scan recording. This technique differs radically from the scheme used in QIC drives, which record data by moving a tape past a stationary recording head. With each pass of the tape, the drive records one track, so that it first records track 0 while the tape moves from left to right, then track 1 as the tape moves from right to left, and so forth.

Because the recording sequence in QIC drives snakes back and forth across the tape, the technique is called *serpentine recording*. The individual tracks—18 in the case of QIC 150—are parallel to each other and to the edge of the tape. To ensure that the drive can read each track clearly without cross-talk from nearby tracks, the tracks are separated from each other with blank space, or guard bands.

With helical scan recording, the recording heads are mounted on a drum that spins at high speed while the tape moves slowly past. In an 8-mm. drive, the drum spins at 1,800 rpm, while the tape moves at 10.89 mm. per second. In a 4-mm. drive, the drum spins at 2,000 rpm, while the tape moves at 8 mm. per second.

The drum is located some distance from the cartridge, so that when you insert the tape, the mechanism pulls the tape away and wraps it partly around the drum. Since the drum is canted slightly in relation to the tape (5 degrees for 8-mm. devices and 6 degrees for 4-mm. units) the tape follows a helical path in relation to the drum.

As the tape moves past the drum, the path for the recording head—and therefore the path for each track—is a diagonal slash across the tape. While the tape is wrapped around the drum, however, the diagonal slash takes the form of a partial helix, yielding the name *helical scan recording*.

Unlike QIC drives, helical scan drives do not need to leave blank space on a full tape. Rather, they can overlap the tracks, so that each track is partly overwritten by the next. This trick is managed in 4-mm. drives by having two recording heads that alternate between successive tracks, and by having each recording head lay down data at a different angle within the tracks.

The angle, or azimuth, for the 4-mm. recording heads are +20 degrees for one and -20 degrees for the other. Together they create a herringbone effect for the recording pattern on the tape. When reading from the tape, the drive heads can pick out data written at the appropriate angle, and ignore the overlapping track with the wrong azimuth. Current 8-mm. drives do not overlap the tracks, and depend instead on a guard band between tracks.

THE MARKETPLACE

Since it introduced 8-mm. tape drives three years ago, Exabyte has practically had the high-capacity backup market to itself. But with DAT drives now reaching for the 2GB mark, 8-mm. tape drives are facing competition.

A lot of vendors are jumping on the DAT bandwagon. Among drive manufacturers, Alliance, Archival Storage Devices, Archive, GigaTrend, Hewlett-Packard, WangDAT, and Wangtek

Significantly, the QIC formats permit substantial upgrade paths. According to the QIC specifications, QIC 80 drives can read the QIC 40 format, QIC 128 drives can read the QIC 100 format, and QIC 380 drives can read the QIC 80, QIC 100, and QIC 128 formats. The QIC 380 specification is also designed to read the Irwin 80, Irwin Magnetic Systems' proprietary format. In theory, this level of compatibility will let you upgrade to later, higher-capacity drives without having to re-record all your old archive tapes.

The QIC specifications also offer the same promise of upgrade potential for drives that use full-sized cartridges. Recording formats for the full-sized cartridges include QIC 24 (60MB), QIC 120 (125MB), QIC 150 (150MB and 250MB), QIC 525 (320MB and 525MB), and the recently announced QIC 1350 (1.35GB). Like the awaited QIC 380 minicartridge format, the QIC 1350 will also be available by 1991.

According to the QIC standards, QIC 120 drives are able to read the QIC 24 format, QIC 150 drives are able to read the QIC 120 and QIC 24 formats, QIC 525 drives are able to read the QIC 120 and QIC 150 formats, and QIC 1350 drives are able to read the QIC 525 format.

Unfortunately, the QIC compatibility charts imply a higher level of compatibility than actually exists. In general, the QIC recording formats define only the physical parameters for writing data—including the number of tracks, width of each track, position of each track, and so forth. With the exception of QIC 40 and QIC 80, the QIC specifications do not say anything about the logical format, which is how the information is written, what it means, or how to interpret it.

The inclusion of the logical format in the QIC 40 and QIC 80 specifications means that you should be able to exchange cartridges among any QIC 40 or QIC 80 tape drives. In general, however, this level of compatibility doesn't exist for other QIC drives, since the backup program that comes with the tape drive uses its own logical format.

In practice, this means that if you take a QIC 150 tape written with, say, Maynard's *MaynStream* backup program, and try to read it using Tallgrass Technologies' *FileSecure* program, you won't succeed. Even though *FileSecure* will recognize that data is on the tape, the program won't be able to interpret it.

Of course, there are exceptions. Any tape drive that uses third-party software, such as Sytron Corp.'s *SY-TOS*, should be able to read any tape that was written with that software; *SY-TOS* uses the same logical format regardless of the drive. Similarly, any drive that uses Sytron's *Sytos Plus* should be able to read any tape that was created with *Sytos Plus* or *SY-TOS*. (For more information on these two programs, see the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*.")

MIXING AND MATCHING

In some cases, you can also exchange tapes by using a tape drive from one vendor with another vendor's software. For example, Wangtek says that its QIC 150 drive will work with Tecmar's *QTOS* and Mountain's *FileSafe* programs. Thus, the Wangtek drive should be able to read tapes that were written with either of those programs, but only if you have copies of the programs to run on the Wangtek drive.

Exchanging tapes is a bit more complicated than it seems. Backup software must be written for a specific interface, and the QIC specifications allow more than one interface for a given QIC format. The choices for QIC 150 drives, for example, are QIC 36, QIC 02, SCSI, and SCSI-II interfaces.

> Unfortunately, the QIC compatibility charts imply a higher level of compatibility than actually exists—the QIC recording formats define only the physical parameters for writing data and don't cover the logical format.

Clearly, a QIC 150 drive with, say, a QIC 36 interface board will only work with software that was written for a QIC 36 card—but it won't work with all such software. With QIC 36 in particular, you'll hear vendors say things like, "It works with any software written for the Everex interpretation of the QIC 36 interface." Later specifications, such as those for the QIC 02 interface, are generally more standardized across tape drives. The bottom line: anytime you want to upgrade your tape backup system or use tape for data exchange, you have to explore compatibility issues on a case-by-case basis.

are shipping or have announced DAT packages, with software. Julie Jeffryes of Strategic Market Data Inc., a Santa Barbara, California research firm, says other vendors with current or announced products include CMS Enhancements, DEC, Emerald, Everex, Identica, Irwin, Maynard, Micronet, Mountain, Palindrome, Procom Technology, Summus, Sysgen, Tallgrass, Tecmar, and Unisys.

Only two drive manufacturers—GigaTrend and Mitsumi—support both DAT formats, DDS (Digital Data Storage, a storage format developed by Sony and Hewlett-Packard) and Data/DAT. Hitachi, Sharp, JVC, Archival Storage Devices and, soon, Panasonic are building Data/DAT drives. Sony, WangDAT, Wangtek, Hewlett-Packard, Archive, and Alliance Technology all support DDS.

Even QIC technology can't be ruled out of the high-capacity market. In one case, 3M Corp. has demonstrated an engineering model of a 5.25-inch, half-height 1.35GB QIC-1350 drive. 3M will not manufacture this drive, but plans to license other manufacturers to produce it. According to 3M, products may be available by early 1991.

QIC technology has at least two advantages over 4-mm. and 8-mm. technology. First, QIC packages cost less than 4-mm. or 8-mm. systems. Second, new high-capacity QIC drives will be able to read tapes you already have from earlier generation QIC drives.

If compatibility with a library of cartridges is what you need from a tape technology, you'll want to stay with QIC. But if you're about to build a tape library, 4-mm. DAT or 8-mm. helical scan drives may make more sense. ■

FORTUITOUS SIMILARITIES

Compatibility issues aside, most of the tape drives reviewed here are more alike than different. That's because drive hardware is a mature technology that varies little in quality from one manufacturer to the next.

In fact, the majority of drives come from only three sources. Of the 212,000 QIC 150 drives that were shipped in 1988, 31 percent came from Wangtek, 30 percent from Tandberg Data, 18 percent from Archive, and 12 percent from Cipher (which is now a division of Archive), according to Bob Abraham of Freeman Associates, an organization that tracks trends in tape drive systems. The remaining 9 percent came from all other manufacturers, including Alloy, California Peripherals, CMS Enhancements, Hewlett-Packard, Mountain Computer, Sankyo Seiki, and Tallgrass.

Similar figures on interface boards were unavailable, but the variety of cards supplied for this roundup suggest that you'll see a wider range of choices. Although Everex Systems supplied five of the 23 interface boards we looked at, most cards showed up in only one package, usually bearing the name of the drive vendor.

If one interface board doesn't emerge from the masses to announce itself a clear standard, two software packages do. Twelve of the 23 systems we evaluated use either *SY-TOS* or *Sytos Plus* as their primary backup program. And even some drives that come with proprietary software, including those from Everex Systems and Irwin Magnetic Systems, will work with *SY-TOS* as well. Compaq's offering is notable for providing an OS/2 version of *SY-TOS* along with the DOS version.

Consider any drive that comes with *SY-TOS* or *Sytos Plus* to be one of the crowd. But keeping compatibility issues in mind, that's not necessarily a weakness. Even if

THE BIG SQUEEZE: Data Compression Comes to Hardware

by M. David Stone

Software-based data compression is hardly new. Compressed files have long been used on on-line bulletin boards to cut down file-transfer times and to lower phone bills. Programs like Fifth Generation System's *Fastback* let you use compression to minimize the number of floppy disks you'll need for a backup. But soon you'll have three new ways to squeeze more information onto a tape, disk, or other device—and they are all hardware solutions.

The new offerings, known as data-compression coprocessors, are the Mystic chip from Hewlett-Packard, the IC-105 chip from InfoChip Systems, and the 9703 and 9704 chips from STAC. All these chips are meant to sit in the data stream and compress data with little or no intervention by the user.

Hewlett-Packard's Mystic and STAC's 9703 and 9704 chips are designed specifically for backups. When used in tape drives, these chips will unobtrusively compress data during backup and decompress it during restoration.

InfoChip Systems' IC-105 is designed for general use. Install an IC-105 in your PC, and it'll compress data going to any kind of storage system, and then decompress the data when it's read back into memory.

Why is hardware-based data compression more desirable than software-based compression? It takes less time. Turn on data compression in a backup program, and backups take longer, since the PC must compress the data before sending it to the backup disk or tape.

Hardware-based compression goes after this problem more directly. If a data-compression coprocessor can keep up with the rest of the system, there is no time penalty. And given that the bottleneck in tape backup is often the speed with which the data is written to the tape, compressing the files can actually speed backups.

WHAT WE FOUND

Two of the tape drives we evaluated—Tallgrass Technologies' FS 150e and Colorado Memory Systems' QFA500—offer data-compression options. Although both use STAC's STACPACK data-compression algorithm, Tallgrass' package uses it in software, while Colorado Memory Systems includes a STAC chip as part of the hardware. (The InfoChip Systems and Hewlett-Packard chips will be available as part of other backup products by the end of 1990.)

On PC Labs' file-by-file portion of the Full Disk Backup test, both systems offered approximately a 2:1 compression ratio. However, software-based Tallgrass' backup speeds were 1.3 to 1.5 times slower with compression than without it. Colorado Memory Systems QFA500 took about 20 percent less time to complete our backup and restore tests with its compression option enabled.

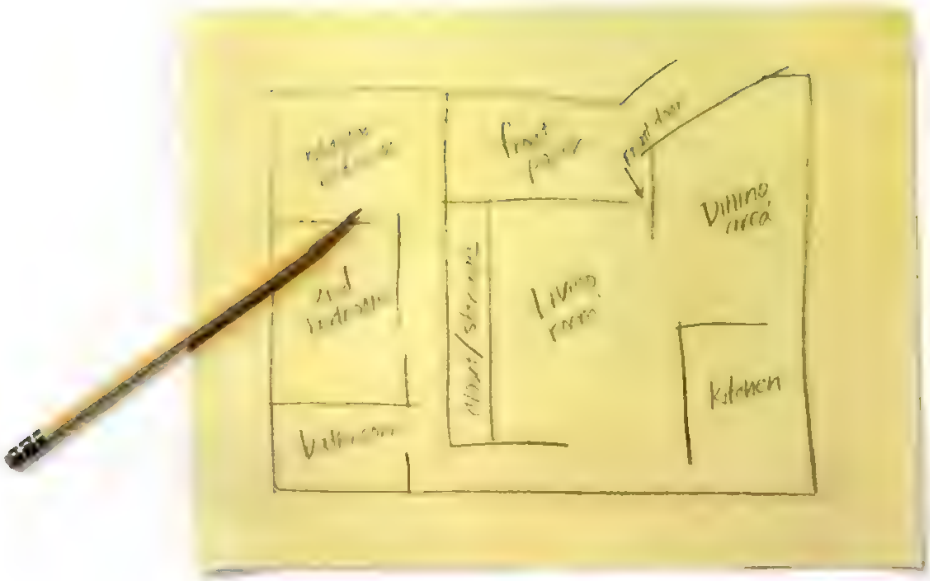
According to Colorado Memory Systems, the STAC chip has the potential to increase backup speed by as much as 40 percent. Due to the nature of our tests, its performance was hampered by a software feature.

The QFA500's software keeps track of the hard disk's directory structure during a backup. Normally, this is handled in RAM. But since our tests involve more than 1,500 files, the program was forced to write to disk, which slowed the backup. Colorado Memory Systems is modifying the software so that it will allow the use of LIM EMS memory, if available, before writing to the disk.

WHICH ONE WILL FLY?

It's clear that hardware-based data compression is here to stay. Far less clear is whose data compression scheme you're most likely to wind up using.

Odds are that all three schemes will succeed to some extent. STAC is an official QIC specification (QIC-122). The Hewlett-Packard Mystic chip has an established following, since it's basically an updated version of the Magic chip that HP has been shipping in 9-track reel-to-reel systems since 1987. The InfoChip IC-105 is appealing because it will provide data compression for your whole system. If it works as advertised, it'll effectively double disk drive and backup capacity—and it should be a lot cheaper than buying a new hard disk! ■



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you prefer a particular proprietary program, the ability to also work with *SY-TOS* or *Sytos Plus* is an important feature.

WHAT TO LOOK FOR

On the other hand, it is primarily the software that gives a tape drive its own personality. Features you should insist on in any package are the ability to specify particular files and directories for backup or restoration, and the ability to specify whether subdirectories should be included in those operations. You should also have a way to record a specific selection of files for future use, and the flexibility to restore files to a different path and disk than those from which they were backed up.

Other things to look for include batch files, macros, and the ability to automate backups. The easier the backup system is to use, the more likely that you'll use it. If you plan to use the system on a network, be sure the package offers full support for any special files or file features provided by that network.

> The longer the tape, the longer the average time for finding a file. Any time saved is important.

Don't be surprised to find that many programs (including *Sytos Plus*) do not offer image backup, a technique that involves backing up data sector by sector, without keeping track of files. And even programs that have this option tend to hide it. Conventional wisdom holds that image backup is faster than file-by-file backup. However, as the results on the PC Labs performance tests show, this is not the case with QIC 150 drives. Since there is no way to restore individual files with a true image backup, and no speed advantage either, there is generally little point in using the feature in the first place.

QUICK FILE ACCESS

One feature that addresses the special needs of PC users is Quick File Access, a technique that lets you find and restore a single file that's buried somewhere on a 150MB or 250MB tape—fast. Without QFA, the software can only search sequentially through the tape, reading as it goes, until it eventually finds the file you're looking for.

The longer the tape, the longer the average time for finding a file. Since most restores are time-critical, taking place during working hours after having trashed an important file, the time spent searching for it can be a real impediment to getting work done. Any time saved is important.

QFA borrows a concept from random access media, and builds an index to the tape. To restore a file, the software searches the index first, finds out where the file is located, and then goes to the appropriate spot, without having to read everything between the beginning of the tape and the start of the file.

The capability for QFA is built into a drive's firmware, but the actual feature is handled by software. *Sytos Plus*' drivers, for example, query the drive to find out if QFA is available, then use the feature if it's there.

Because QFA is a concept rather than a specification, the actual scheme differs from one backup program to the next, in much the same way that the logical format for data differs. But like the logical format for data, the QFA format remains the same for any given program, regardless of the drive. Thus, a tape written by a Wangtek drive using *SY-TOS* with QFA should be readable by an Alliance drive, since it can also use *SY-TOS*. Of the 23 systems we reviewed, 10 offer QFA.

In the 23 reviews that follow, you'll find that some packages offer QFA, some have data-compression options, and some have distinct personalities thanks to proprietary software. If a storage capacity of 150MB or 250MB per tape without compression (or up to twice that with data compression) is what you're looking for, one of these systems should meet your needs.

ALLIANCE TECHNOLOGY INC.

Alliance QA150-EXAT

by M. David Stone

In many ways, Alliance Technology's QA150-EXAT exemplifies the tape backup systems reviewed in this roundup. Available in both internal and external versions, the unit offers quick file access, comes with third-party software, and handles standard-length (150MB) and extended-length (250MB) cartridges. The $1,395 package we tested includes a Sankyo Seiki external drive, an Alliance ISA interface board, version 1.10 of Sytron's *Sytos Plus* backup software, and a one-year warranty. An internal version of the system costs $1,295.

An unusually wide choice of backup software differentiates the Alliance QA150-EXAT from its competitors. As alternatives to *Sytos Plus*, Alliance offers Sytron's *SY-TOS* at the same system price and Emeritus Technologies' *TapeWare* for an additional $200. According to Alliance, at least one more software package, Gazelle Systems' *BACK-IT 4 LAN*, will be available by the time this article is published. In addition, Alliance claims you can use standard Novell *NetWare* utilities, NBACKUP or VAP, to back up your network to the QA150-EXAT.

As you might expect, each of these programs has advantages. *SY-TOS* and *Sytos Plus* are industry standards that support DOS as well as Novell *NetWare 286* and 3Com networks; *Sytos Plus* works with *NetWare 386*, too. NBACKUP and VAP, which are distributed at no charge by Novell, are utilities that many *NetWare* users may already have. *TapeWare*, which supports DOS and *NetWare 286*, is a value-added process that lets you directly connect the QA150-EXAT to a file server and issue a command from any workstation to back up the server. *BACK-IT 4 LAN*, which works under DOS and *NetWare 286* and *NetWare 386*, is extremely easy to

PC FACT FILE
EDITOR'S CHOICE

Alliance QA150-EXAT
Alliance Technology Inc., 510 Lawrence Expressway, Sunnyvale, CA 94086; (408) 739-4200.
Software: *Sytos Plus* 1.10; *TapeWare* (DOS and Novell).
List Price: External drive, ISA board (with *Sytos Plus*), $1,395; internal drive, ISA board (with *Sytos Plus*), $1,295; external drive, MCA board (with *Sytos Plus*), $1,595; internal drive, MCA board (with *Sytos Plus*), $1,495.
Requires: DOS 3.*x* or later, 512K RAM.
In Short: A large variety of third-party software makes the moderately priced Alliance QA150-EXAT package easier to match to your needs than many other systems. Its small footprint makes it a good choice for stacking with an external modem.

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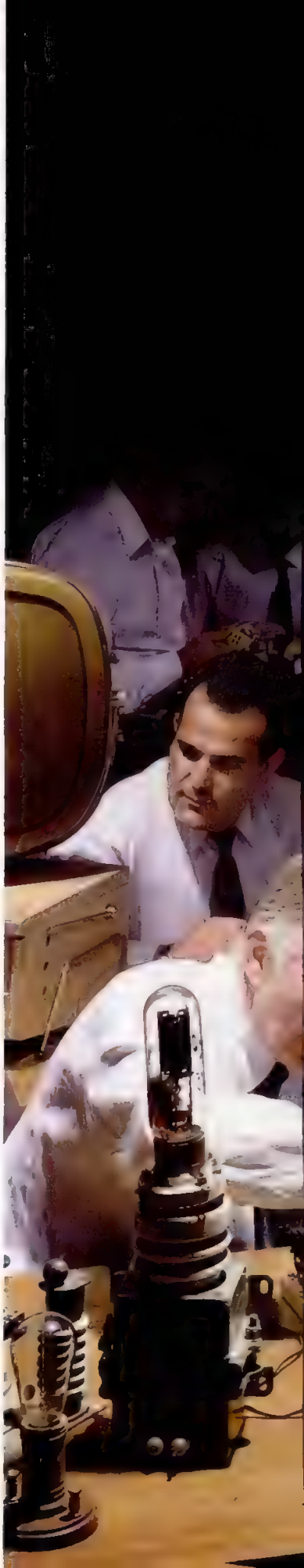

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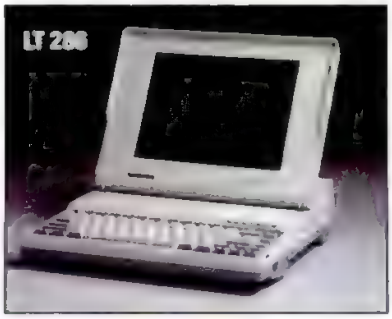

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82-key keyboard emulates 101-key keyboard with embedded keypad and 12 function keys; password security; supports external keyboard and 10-key keypad.

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HARDWARE HUMOR. Overheard from a recommender in a large corporation, "with all the direct sales companies these days, it's getting harder and harder to get a decent lunch".

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CIRCLE 312 ON READER SERVICE CARD

use, according to Alliance. Thus, whether you are a power user or a network manager, you can customize the Alliance package by choosing the software that best suits your needs.

NO DIFFERENCES

No matter which software you choose, hardware installation will remain constant. Simply plug the 8-bit Alliance QIC-36 interface board into an empty slot in your PC, plug a power connector into the board, and plug the supplied cable into the board and the tape drive. (Alliance also supplies a "Y" cable, in case you don't have an available connector on your power supply.) Jumpers on the board let you adjust the IRQ, DMA channel, and address; however, the factory settings should work with most systems. *Sytos Plus* comes with an installation program that automatically copies the files to your hard disk and installs them. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *Sytos Plus*.)

Also worth mention is the unit's relatively small footprint. At 3 by 6 by 9.75 inches (HWD), the drive is just the right size to stack on top of an external modem. And if you have a PS/2, you're not out of luck: Alliance offers an external unit with an MCA card for $1,595 and an internal package for $1,495.

On the PC Labs performance tests, the Alliance QA150-EXAT took about 29 minutes to complete a file-by-file backup, and 28 minutes to restore that data to disk. It took approximately 9 minutes to complete our Single Directory Backup test, and about 8.5 minutes to restore that subdirectory to the hard disk. *Sytos Plus* does not support image backup.

Although these performance times are

STANDARD SOFTWARE: SY-TOS and Sytos Plus

by M. David Stone

In general, vendors of tape backup systems that use proprietary software resist referring to Sytron Corp.'s *SY-TOS* and *Sytos Plus* as industry standards. But given that 12 of the 23 systems reviewed here include either *SY-TOS* or *Sytos Plus*, it seems a reasonable claim for Sytron.

Compatibility at the data-interchange level comes from software. In theory, any two drives that run *SY-TOS* should be able to read each other's tapes. Similarly, any two drives that run *Sytos Plus* should be able to do the same. According to Sytron, each of its programs remains essentially unchanged from one system to the next, differing only in hardware drivers.

SY-TOS and *Sytos Plus* have different data formats, so a drive running one cannot normally exchange tapes with a drive running the other. However, an option in *Sytos Plus* allows you to set the program to *SY-TOS* format. Thus, you can upgrade from *SY-TOS* to *Sytos Plus*, and your drive should still be able to read your old tapes.

SY-TOS

SY-TOS offers every feature you could ever need, but it lacks a logical internal structure. For example, to do a file-by-file backup of an entire disk, you go to the Set menu, pick the Select option, accept the defaults to include all files and subdirectories, and then go back to the main menu to pick Backup. On the Backup menu, you choose File (for file-by-file backup) and then Selected to use the selection you made on the Set/Select menu.

Other backup choices include Backup File List, which won't let you include subdirectories, and Backup Disk, which yields a modified image backup. The modified image backs up only that part of the disk with data on it. It also interprets the File Allocation Table, so you can restore individual files from the backup. *SY-TOS* supports full image backup, but this choice is hidden in the Option menu under Option Device Backup.

Once you learn its menu structure, you can get *SY-TOS* to handle just about any backup or restore task, from a single file to multiple disks. It can also restore files to any drive or path. A batch file generator lets you record a set of commands for automatic playback at future sessions.

Sytron is well aware of *SY-TOS*'s problems with menu structure. In fact, the company has discontinued development of *SY-TOS* and is directing its efforts at *Sytos Plus*, because of "user interface issues." While Sytron will provide *SY-TOS* to those who want it, the product has reached a dead end.

Sytron says that *SY-TOS* will work with networks running Novell *NetWare 286* or IBM *PC LAN* as well as with those from 3Com. Because it's NetBIOS-compatible, it may also work with other NetBIOS networks.

SYTOS PLUS

Sytos Plus offers essentially the same features as *SY-TOS*, but its look and menu structure are drastically different. If you're planning to upgrade from *SY-TOS* to *Sytos Plus*, you'll have to learn an entirely new program. But you'll also be thankful for the improvements.

Sytos Plus uses a combination of function keys, Alt-key pull-down menus, and point-and-shoot menus. Its structure can be overwhelming compared to that of some other tape backup programs, but at least it's consistent.

The program makes basic backup tasks extraordinarily easy. For example, when you start *Sytos Plus* for the first time, it wakes up with a file-by-file backup procedure already defined. To backup, you only have to pick the Run Procedure from the function key choices. To restore, you pick "P" for Procedure, "L" for Load, then load the predefined restore procedure and run it. Modifying the procedures is also straightforward.

Missing from *Sytos Plus* is any form of image backup. Added is network support for Novell's *NetWare 386*. According to Sytron, the next release of the program will also support Microsoft's *LAN Manager* version 2.0, and *LAN Server* version 1.2. Sytron claims that by the time this is article is published, Microsoft will be bundling *Sytos Plus* together with *LAN Manager*, and will include the drivers for 12 tape drives. Additional drivers will be added as they become available. In addition, the next release of *Sytos Plus* will also have a data-compression option, which will use a new, faster version of the STAC algorithm. ■

on the slow side of average, they shouldn't be an issue. The Alliance QA150-EXAT's marginally slow performance is far less important than its ability to work with a variety of backup programs. All told, the Alliance QA150-EXAT has a lot going for it. At $1,395 list, rate this one a good buy.

BI-TECH ENTERPRISES INC.

Bi-Tech 150 SCSI Tape Kit QIC

by M. David Stone

Given its list price of $875 as reviewed, you might be tempted to think of Bi-Tech Enterprises' 150 SCSI Tape Kit QIC package as a bargain-basement solution. Think again. Although the system is among the least expensive in this roundup, its performance is among the best.

The Bi-Tech 150 SCSI Tape Kit QIC consists of a Cipher drive, a Bi-Tech 2120 SCSI board, and version 2.85 of Bi-Tech's *Fullback* software. We evaluated an internal ISA model, but Bi-Tech also offers an external version for $1,075 as well as internal and external MCA versions for an additional $175 each. All prices include a one-year warranty.

Like most of the drives we tested, the 150 SCSI Tape Kit QIC can store data on both standard-length (150MB) and extended-length (250MB) cartridges. Unlike many, the package does not include a quick file access feature. *Fullback* supports Novell *NetWare 286* and 3Com networks, according to Bi-Tech, but will not work with other third-party software.

FACT FILE

Bi-Tech 150 SCSI Tape Kit QIC
Bi-Tech Enterprises Inc., 10 Carlough Rd., Bohemia, NY 11716; (516) 567-8155.
Software: Proprietary.
List Price: Internal drive, ISA board (with software), $875; external drive, ISA board (with software), $1,075; internal drive, MCA board (with software), $1,050; external drive, MCA board (with software), $1,250.
Requires: DOS 3.0 or later, 330K RAM.
In Short: Bi-Tech's proprietary software has a primitive look and feel, with little attention to such details as screen design or menu structure. However, what the system lacks in visual appeal and intuitive commands it makes up for in fast performance and low price.

CIRCLE 604 ON READER SERVICE CARD

Hardware installation involves sliding the drive into an empty 5.25-inch, half-height drive bay, plugging in the 8-bit SCSI board, connecting a ribbon cable between the card and the drive, and connecting a power cable to the drive. Then, you run an installation program that automatically reads the DMA setting on the board and adjusts the software accordingly. The address changes automatically when you change the DMA channel.

UNCOMPRESSING FILES

Bi-Tech's software is primitive in some ways. For example, since it's one of the few packages that lacks an installation module, you must create a directory on your hard disk, copy the files from the distribution disk, and then run a program to uncompress the files.

The 150 SCSI Tape Kit QIC is also one of the few packages that has more than one core program. For a file-by-file backup of a hard disk, you use the BACK program, which generates a batch file for the *Fullback* module. For an image backup or restore, you can use the BACK program to create a batch file, or you can use *Fullback* directly. Old hands won't have trouble navigating their way through the package's Spartan menus. Novices might.

> Although the Bi-Tech is among the least expensive, its performance is among the best.

On the PC Labs file-by-file performance tests, the Bi-Tech completed the backup in 20.5 minutes and the restoration in about 25 minutes. On the directory tests, the drive performed the backup in 5 minutes and the restoration in 6 minutes. The software also offers image backup, which took about 30 minutes for the backup and 54 minutes for the restoration. Image restore is considerably slower than backup, because the software merely notes blank space during backup but recreates it on disk during restoration.

The Bi-Tech drive is a classic "techie" product—strong on performance, but weak on menu design and ease of use. If you don't mind roughing it, this combination of price and performance will be hard to beat.

CMS ENHANCEMENTS INC.

TapeMaster 150E

by Bruce Brown

Moderate price, average performance. That description sums up CMS Enhancements' TapeMaster 150E, a $1,495 package that, as reviewed, includes a 3.75- by 10- by 10.5-inch (HWD) external tape drive, a QIC 02 ISA interface board, and version 3.0 of Sytron's *SY-TOS* software. Both the tape drive and the interface board are manufactured by CMS Enhancements, which also sells an internal, half-height version of this drive for $1,395 and an external version with an MCA interface board for $1,695.

The TapeMaster 150E drive accommodates standard-length tapes for backups of up to 150MB and extended-length tapes for backups of up to 250MB. *SY-TOS* supports image backup and restoration, and makes the device compatible with most networks, including those of Novell (both *NetWare 286* and *386*), 3Com, Banyan, and IBM. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *SY-TOS*.) Quick file access is not on this system's list of options.

By the time this article is published, CMS Enhancements will have released its own backup software, *Tape Master*, which will support networks and provide data-compression capabilities. The price of the system with the new software will remain the same.

FACT FILE

TapeMaster 150E
CMS Enhancements Inc., 1372 Valencia Ave., Tustin, CA 92680; (714) 259-9555.
Software: *SY-TOS* version 3.0.
List Price: External drive, ISA or EISA board, $1,495 (with software); internal drive, ISA or EISA board, $1,395 (with software); external drive, MCA board, $1,695 (with software).
Requires: DOS 2.1 or later, 512K RAM.
In Short: Moderate price, average performance, and no surprises sum up the TapeMaster 150E external tape backup system. The unit's wide availability at a discount price encompasses its attractiveness.

CIRCLE 605 ON READER SERVICE CARD

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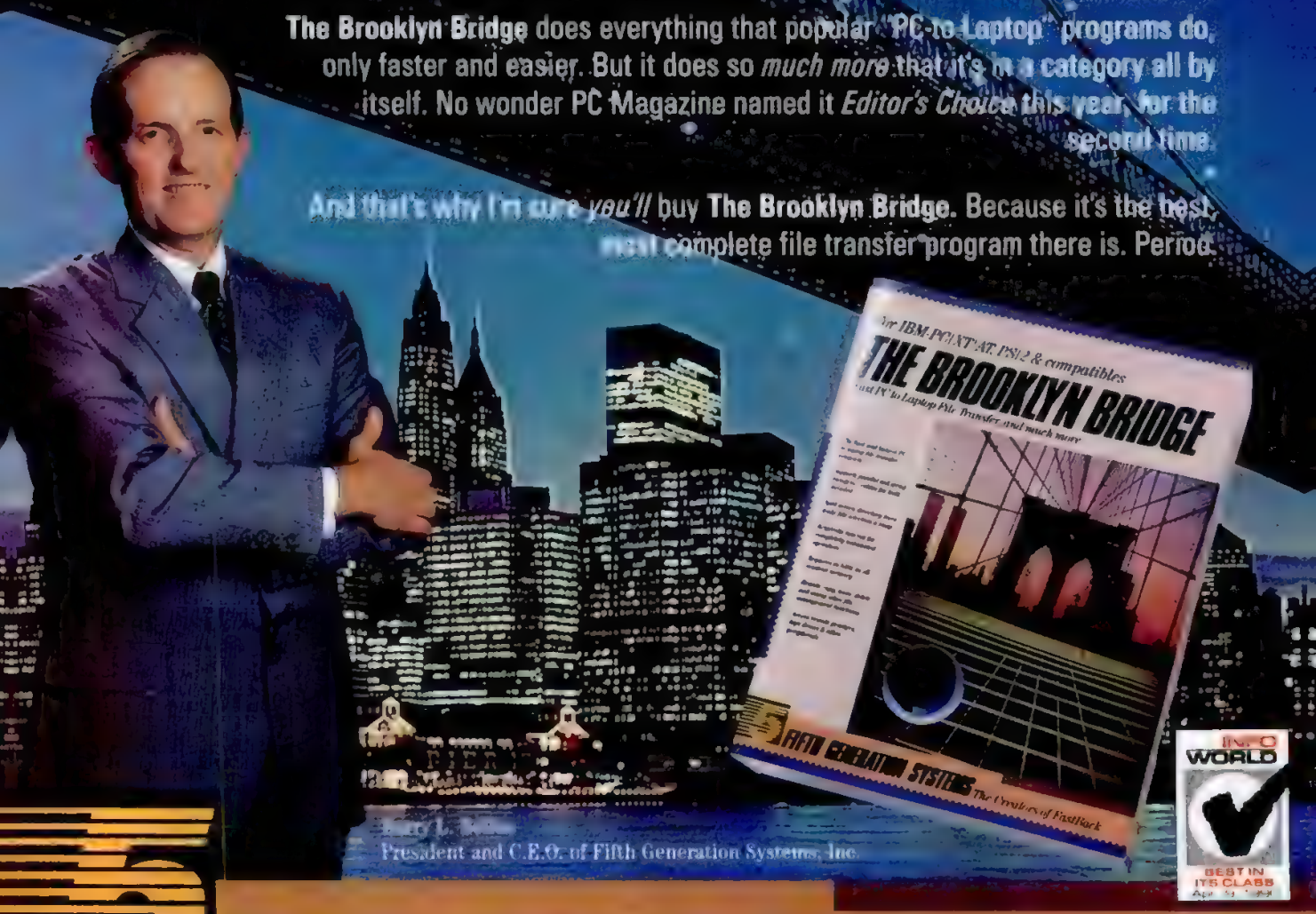

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For a complete list of features and specifications, or to buy The Brooklyn Bridge, visit your leading computer dealer. Or, call 1-800-873-4384 for more information.

TAPE DRIVES: SUMMARY OF FEATURES

	Osicom Technologies Inc. **Osicom Osibak 150S**	Identica/ Division of Prima International Inc. **Identica IDT150**	★ Alliance Technology Inc. **Alliance QA150-EXAT**	Bi-Tech Enterprises Inc. **Bi-Tech 150 SCSI Tape Kit QIC**	Sankyo Seiki (America) Inc. **Sankyo ET 150 E**	Tense Lectronix Corp. **TLC Legacy 150x²**	Tandberg Data Inc. **Panther 150**
List price	$820	$1,325	$1,395	$875	$1,395	$1,399	$1,460
PHYSICAL CHARACTERISTICS							
Device type	Internal	External	External	Internal	External	External	External
Dimensions (HWD, in inches)	5.34 x 1.5 x 8	3.75 x 5.75 x 13	3 x 6 x 9.75	5.34 x 1.5 x 8	2.75 x 7.5 x 12.25	2.25 x 6 x 13.5	3.75 x 6.5 x 13.75
Interface as tested	ISA 16-bit	ISA 8-bit	ISA 8-bit	ISA 8-bit	ISA 8-bit	ISA 16-bit	ISA 8-bit
Other interfaces available	None	PS/2 MCA	MCA	MCA	MCA	ISA 8-bit, MCA	ISA 8-bit, MCA
I/O board manufacturer	Future Domain	Everex Systems	Alliance Technology	Bi-Tech Enterprises	Everex Systems	TLC Legacy	Everex Systems
Format	SCSI	QIC 36	QIC 36	SCSI	QIC 36	QIC 02	QIC 02
Powered by host computer or external AC source	Host	External	Host	Host	External	External	External
Recording medium included	■	❑	■	❑	❑	❑	■
Capacity of recording medium without data compression	150MB	150MB	150MB	150MB	150MB	150MB	150MB
Device manufacturer	Cipher	Sankyo Seiki, Identica	Sankyo Seiki	Cipher	Sankyo Seiki	Legacy Manufacturing	Tandberg Data
Media speed (inches per second)	90	72, 90	72	90	72, 90	90	72
SOFTWARE CHARACTERISTICS							
Software provided (as tested)	*SY-TOS*	*SY-TOS*	*Sytos Plus*	Proprietary	*SY-TOS*	*Sytos Plus*	*SY-TOS*
Password protection	■	■	■	❑	■	■	■
Data compression	❑	❑	❑	❑	❑	❑	❑
BACKUP CHARACTERISTICS							
Backup types permitted:							
Image	■	■	❑	■	■	❑	■
Modified image	❑	■	❑	❑	■	❑	■
Append image backup	■	■	N/A	■	■	N/A	■
Backup ranges:							
Multiple partitions	■	■	■	■	■	■	■
Multiple disks	❑	❑	■	■	❑	■	■
RESTORE CHARACTERISTICS							
Can exclude range of files	■	■	■	❑	■	■	■
Can automatically skip existing files	❑	❑	■	❑	■	❑	❑
Can prompt to overwrite existing files	■	■	■	❑	■	■	■
Restore types permitted:							
Image	■	■	❑	■	■	❑	■
Modified image	❑	■	❑	❑	❑	❑	■
Restore ranges:							
Multiple partitions	■	■	■	■	■	■	■
Multiple disks	❑	❑	■	■	❑	■	■
NETWORK CHARACTERISTICS							
Networks supported	*NetWare 286, NetWare 386, 3+Open, VINES*	*NetWare 286, NetWare 386, 3+Open*, IBM *PC LAN, VINES*	*NetWare 286, NetWare 386, 3+Open*	*NetWare 286, 3+Open*	*NetWare 286, 3+Open*	*NetWare 286, NetWare 386, 3+Open*, IBM *PC LAN, VINES*	*NetWare 286, NetWare 386, 3+Open*, IBM Token-Ring
Backup system resides on workstation or server	Workstation	Workstation	Workstation	Workstation	Workstation	Workstation	Workstation
Workstation automatically logs off network after unattended backup	■	■	❑	■	■	❑	❑
Tape system supports multiple volumes on a single tape	■	■	■	■	■	■	■

★ –Editor's Choice ■–Yes ❑–No N/A–Not applicable: the product does not have this feature.

CMS Enhancements Inc. **TapeMaster 150E** $1,495	NovaStor Corp. **NovaStor NST150** $1,495	Wangtek Inc. **Wangtek LS 5150 PK** $1,510	Sysgen Inc. **Sysgen Maxi TS250e** $1,595	MicroNet Technology Inc. **MT-150/DOS** $1,795	Tailgrass Technologies **FSO 150e** $1,795	Colorado Memory Systems Inc. **QFA500** $1,800	Everex Systems Inc. **Everex Excel Stream 150** $1,899	Irwin Magnetic Systems Inc. **Irwin 6451-E** $1,975
External	External	External	External	External	External	External	External	External
3.5 x 10 x 10.5	3.5 x 10 x 10.5	3 x 6 x 14	2 x 12 x 14.25	3 x 10 x 10.5	7.25 x 4 x 14.75	3.5 x 6.75 x 13.75	5.5 x 7 x 15.5	2.5 x 6.5 x 14
ISA 8-bit	ISA 16-bit	ISA 8-bit	ISA 16-bit	ISA 16-bit	ISA 8-bit	ISA 16-bit	ISA 8-bit	ISA 16-bit
MCA	MCA, EISA	MCA	MCA	ISA 8-bit, MCA, EISA	MCA	ISA 8-bit, MCA	MCA	MCA
CMS Enhancements Inc.	Always Technology	Wangtek	Sysgen	Adaptec	Tailgrass Technologies	Colorado Memory Systems	Everex Systems	Everex Systems
QIC 02	SCSI	QIC 02	SCSI	SCSI	QIC 02	QIC 02	QIC 02	QIC 36
External	External	External	External	External	External	Host	External	External
■	❑	■	■	■	■	❑	■	■
150MB	150MB	150MB	250MB	150MB	150MB	250MB	150MB	250MB
CMS Enhancements	Tandberg Data	Wangtek	Archive	Tandberg Data	Cipher	Cipher	Wangtek	Irwin Magnetic Systems
90	90	72	72	72	90	72	72, 90	72
SY-TOS	Proprietary	*Sytos Plus*	*SY-TOS*	*SY-TOS*	Proprietary	Proprietary	Proprietary	Proprietary
■	❑	■	■	■	■	■	❑	■
❑	❑	❑	❑	❑	■	■	❑	❑
■	❑	❑	■	■	❑	❑	■	❑
■	❑	❑	■	■	❑	❑	■	❑
■	N/A	N/A	■	■	N/A	N/A	■	N/A
■	■	■	■	■	■	❑	■	■
■	■	■	■	■	■	❑	■	■
■	■	■	■	■	■	■	■	■
❑	■	■	■	❑	■	■	❑	❑
■	■	■	■	■	■	❑	■	❑
■	❑	❑	■	■	❑	❑	■	❑
■	❑	❑	■	■	❑	❑	■	❑
■	■	■	■	■	■	❑	■	■
■	■	■	■	■	■	❑	❑	■
NetWare 286, NetWare 386, 3+Open, VINES	*NetWare 286, NetWare 386, 3+Open, VINES*	*NetWare 286, NetWare 386, 3+Open*	*NetWare 286, 3+Open,* IBM *PC LAN, 3+Share*	*NetWare 286, NetWare 386, 3+Open*	*NetWare 286, NetWare 386*	*NetWare 286, NetWare 386, 3+Open,* IBM Token-Ring	*NetWare 286, NetWare 386, 3+Open,* IBM Token-Ring, *VINES*	*NetWare 286, NetWare 386, 3+Open,* IBM *PC LAN*
Either	Either	Either	Workstation	Workstation	Workstation	Workstation	Either	Workstation
■	■	❑	❑	❑	■	■	■	■
■	■	■	■	■	❑	■	■	■

CONTINUES

TAPE DRIVES: SUMMARY OF FEATURES

	Compaq Computer Corp. **150/-250-Megabyte Tape Drive**	Tecmar Inc. **Tecmar QT-150e**	Maynard Inc. **MaynStream 150Q**	NCR Corp. **NCR 6091 150 MB SCSI Tape SubSystem**	CORE International Inc. **COREtape CT150/250E**	Emerald Systems Corp. **Emerald Systems RapidRecover 150 Model RAP150-9000**	Mountain Network Solutions Inc. **FileSafe 7250**
List price	$1,999	$2,095	$2,195	$2,249	$2,295	$2,095	$2,495
PHYSICAL CHARACTERISTICS							
Device type	Internal	External	External	External	External	External	External
Dimensions (HWD, in inches)	5.34 x 1.5 x 8	7 x 4 x 14.75	3.75 x 6.5 x 15	4.75 x 6.5 x 14.5	3.25 x 6 x 10.75	3.5 x 8.5 x 10.5	6.5 x 4.5 x 12
Interface as tested	ISA 8-bit	ISA 8-bit	ISA 8-bit	ISA 16-bit	ISA 16-bit	ISA 8-bit	ISA 16-bit
Other interfaces available	None	MCA, NuBus	MCA	ISA 8-bit, MCA	MCA, EISA	MCA, EISA	MCA
I/O board manufacturer	Compaq Computer	Tecmar	Maynard	NCR	Everex Systems	Emerald Systems	Mountain Computer
Format	QIC 02	QIC 02	QIC 02	SCSI	QIC 02	SCSI	QIC 02
Powered by host computer or external AC source	Host	External	External	External	Host	Either	External
Recording medium included	■	■	■	❑	■	■	■
Capacity of recording medium without data compression	250MB	150MB	150MB	150MB	150MB	150MB	150MB
Device manufacturer	Wangtek	Wangtek	Archive	Archive	Archive	Emerald Systems	Sankyo Seiki, Mountain Computer
Media speed (inches per second)	72	72	90	90	72	90	72, 90
SOFTWARE CHARACTERISTICS							
Software provided (as tested)	*SY-TOS*	Proprietary	Proprietary	*SY-TOS*	Proprietary	Proprietary	Proprietary
Password protection	■	❑	■	■	■	■	■
Data compression	❑	■	❑	❑	❑	❑	❑
BACKUP CHARACTERISTICS							
Backup types permitted:							
Image	■	■	■	■	■	❑	■
Modified image	■	❑	❑	■	■	■	❑
Append image backup	■	■	■	■	■	N/A	■
Backup ranges:							
Multiple partitions	■	❑	❑	■	■	■	■
Multiple disks	■	■	■	❑	■	■	■
RESTORE CHARACTERISTICS							
Can exclude range of files	■	■	■	■	■	❑	■
Can automatically skip existing files	❑	■	■	■	❑	■	❑
Can prompt to overwrite existing files	■	■	■	■	■	■	■
Restore types permitted:							
Image	■	■	■	■	■	❑	■
Modified image	■	❑	❑	■	■	■	❑
Restore ranges:							
Multiple partitions	■	■	❑	■	■	■	■
Multiple disks	■	■	■	❑	■	■	■
NETWORK CHARACTERISTICS							
Networks supported	*NetWare 286, 3+Open*	*NetWare 286, NetWare 386, 3+Open*, IBM *PC LAN*, IBM Token-Ring	*NetWare 286, NetWare 386, 3+Open*, IBM Token-Ring	*NetWare 286, NetWare 386, 3+Open, VINES*	*NetWare 286, NetWare 386, 3+Open*	*NetWare 286, NetWare 386*	*NetWare 286, NetWare 386, 3+Open, VINES*
Backup system resides on workstation or server	Workstation	Workstation	Workstation	Workstation	Either	Either	Workstation
Workstation automatically logs off network after unattended backup	❑	■	■	■	■	■	■
Tape system supports multiple volumes on a single tape	❑	❑	■	■	■	■	■

☐ –Editor's Choice ■–Yes ❑–No N/A–Not applicable: the product does not have this feature.

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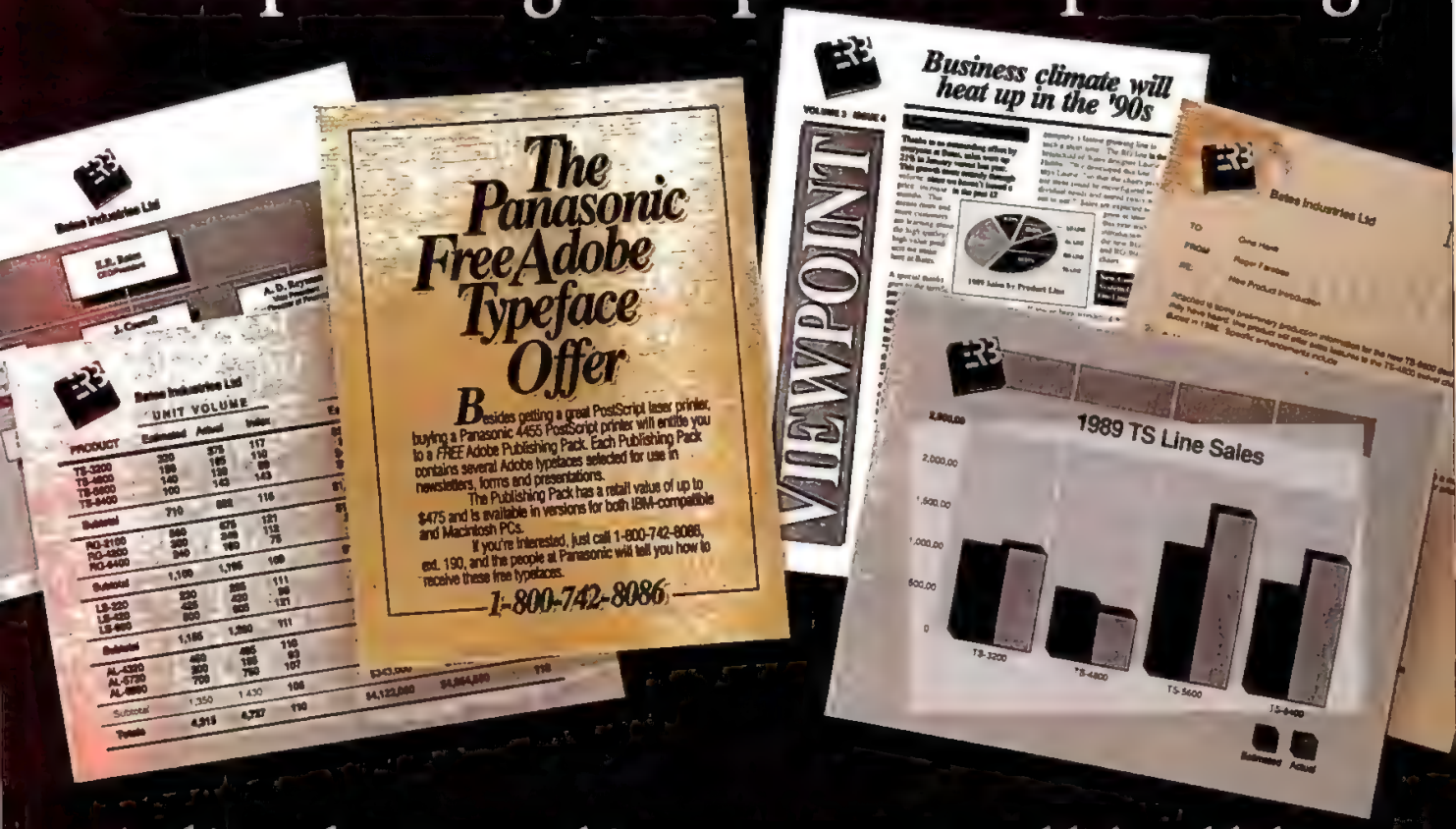

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NOTHING UNUSUAL

If you've installed one external tape drive, you've installed them all, almost. To get the TapeMaster 150E up and running, you just insert the 8-bit QIC-02 board into an available slot in your PC, run a cable between the board and the drive, and plug the power cord into the drive. Next, you run *SY-TOS*'s installation program. If you need to change the settings on the board or in the software, the documentation clearly explains how to do so.

On the PC Labs performance tests, the TapeMaster 150E turned in average results. The device took about 25.5 minutes to complete our File-by-File Backup test, and about the same amount of time to finish our Image Backup test. Image restoration also took about 25.5 minutes, whereas file-by-file restoration took 27.5 minutes. The TapeMaster 150E completed the directory backup and restore tests in 7.5 minutes each.

No single feature makes the TapeMaster 150E stand out from other QIC-150 drives equipped with QIC-02 boards and *SY-TOS*. But if you're looking for a standard system that's easy to install and offers few surprises, this widely available package is a good bet.

COLORADO MEMORY SYSTEMS INC.

QFA500

by Bill O'Brien

It would be difficult to pick the QFA500 out of a crowd because of its physical appearance, but Colorado Memory Systems has tucked a Superman suit under the device's Clark Kent enclosure. In addition to quick file access, CMS has included data compression as a standard feature on this unit and says that a storage capacity of 500MB is not unrealistic.

The QFA500 comes in several configurations and handles both standard-length (150MB) and extended-length (250MB) tapes. The base unit, an internal half-height Cipher drive, costs $1,099.95. We looked at a 3.50- by 6.75- by 13.75-inch external unit, which costs an additional $299.95 for the case and the installation hardware. The heart of the system, a Colorado Memory Systems TC-02 interface board, costs $399.95 for either ISA, EISA, or MCA versions.

A JUMPERLESS DEVICE

The sticker price of the TC-02 should indicate that the board is more than a conduit for passing data between tape and disk. A jumperless device, the TC-02 will configure itself for IRQ, DMA, and addressing from within the software installation routine. It works in either an 8- or 16-bit slot and selects the fastest bus available.

More impressive is the existence of a VLSI-sized chip from STAC that dominates the board. Scribed on its silicon pathways is a QIC 122-compatible data compression scheme. By putting the compression algorithm in firmware, Colorado Memory Systems has departed from the norm in two ways. First, it has made data compression a standard rather than an optional component of the package. Second, it has declared its intention that the QFA500 execute much faster than systems that use software-based compression schemes. (See the sidebar "The Big Squeeze: Data Compression Comes to Hardware" for additional information on data compression.)

> Colorado Memory Systems has tucked a data-compression Superman suit under the QFA500's Clark Kent enclosure.

With data compression turned off, the QFA500 completed the PC Labs File-by-File Backup test in just under 28 minutes, and the Single Directory Backup test in about 8 minutes. A file-by-file restore took about 28 minutes, and a directory restore took about 8.5 minutes. When the QFA500 ran in compression mode, its performance was approximately 20 percent faster for both backups and restores.

The effectiveness of compression, in terms of both time and tape space, is dependent on the format of the data you're backing up. While you should see excellent results with ASCII files, you may find that .EXE and .COM files are resistant to efficient compression. ZIPed or ARCed files permit no further compression. PC Labs' test directory contained a sufficiently diverse data group to swing the compression ratio between 2:1 (the best possible) and 1.2:1 (almost no compression).

PROPRIETARY SOFTWARE

Colorado Memory Systems includes its own *QFA Back Up* software with the package. Installation is as automatic as can be. To configure the TC-02, simply accept the default settings the software has determined and you're ready to go. Standard features include batch, automatic, and command-line modes as well as support for networks from Novell and 3Com.

Assembling the hardware is painless. The back of the casing allows only one connection at the drive I/O port. There are no transformer or power connections to worry about, because power is drawn through the TC-02 interface board via a spare connector from your PC's power supply. The unit will stand either flat or on its side, depending on where you install its rubber feet.

The only problem we encountered during testing was when we tried to restore files to a new path. A phone call to Colorado Memory Systems revealed that this procedure is not part of the software's menu structure, but is accessible from the command line. In fact, some of the better options are also accessible from the command line, making this package an excellent batch-file candidate.

Given its strong command-line orientation and its network support, Colorado Memory Systems' entry should appeal to power users and small-network managers alike. If you're looking for a system that offers latitude in the size of backups it can handle, the QFA500's data compression algorithm should pique your interest.

FACT FILE

QFA500
Colorado Memory Systems Inc., 800 S. Taft Ave., Loveland, CO 80537; (800) 432-5858, (800) 346-9881 (Canada).
Software: Proprietary.
List Price: External drive, ISA, EISA, or MCA board (with software, external case and installation hardware), $1,800; internal drive, ISA or EISA board (with software), $1,500.
Requires: DOS 2.1 or later, 400K RAM.
In Short: The QFA500's TC-02 interface board has a data compression algorithm in firmware, affording it faster operation than devices that use software-based data compression schemes and greater latitude in the size of backups it can handle.

CIRCLE 606 ON READER SERVICE CARD

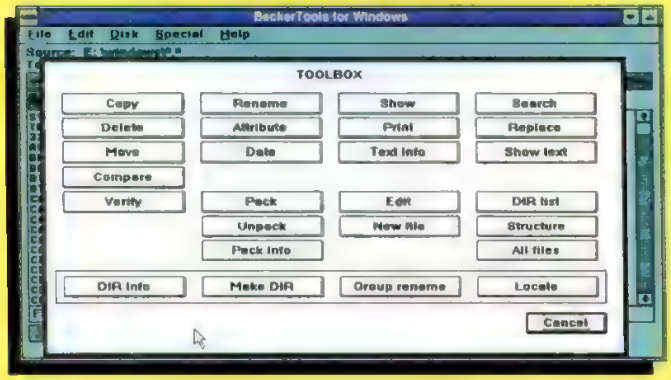
New for Windows 3.0

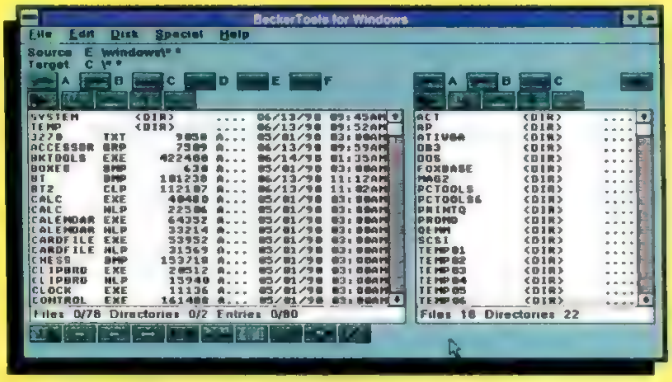
Tools for the WINDOWS™ User

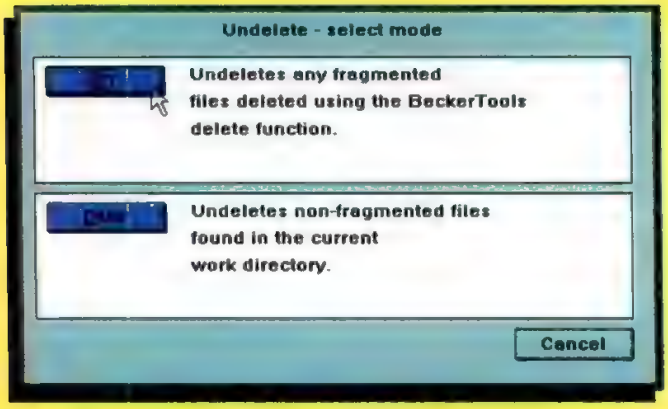
an indispensable set of Windows utilities

If you're a Windows user you'll want **BeckerTools** for Windows. **BeckerTools** dramatically speeds up your file and data management chores and increases your productivity. Where Windows' File Manager functions end, **BeckerTools** features begin by giving you powerful, yet flexible features you need to get the job done quickly. **BeckerTools** has the same consistent user interface found in Windows so there's no need to learn 'foreign' commands or functions.

Manipulating your disks and files is as easy as pointing and clicking with the mouse. You'll breeze through flexible file and data functions that are friendly enough for a PC novice, yet powerful enough for the advanced user. You won't find yourself 'dropping out' of Windows to perform DOS functions like undeleting a file or waiting for a diskette to be formatted. **BeckerTools** gives you these and many other commands at the click of a mouse button.







Some of BeckerTools' features:

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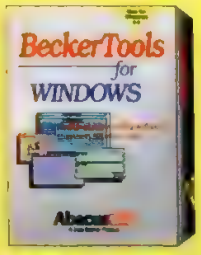
- Copy disks— in one pass, no multiple disk swapping
- Backup (pack files)—hard disk—to multiple diskettes with password protection
- Format diskettes—any capacity supported by your drive and disk type—multitasking too
- Duplicate disks—read in diskette once, make multiple copies
- Compare diskettes—in one pass
- Verify diskettes—handy security check
- Wipe disk—for maximum security
- Delete single or groups of files or directories containing files, including read-only files

Suggested retail price: **$79.95**

System requirements:

- IBM AT, 386 or 100% compatible computer
- Hard disk and Windows 3.0
- Windows not included



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Card #: _____

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PERFORMANCE TESTS: TAPE DRIVES

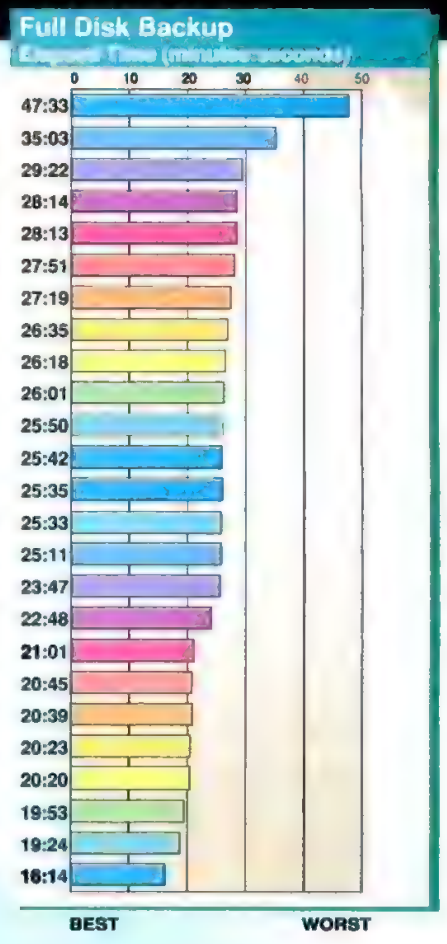
The COREtape and MaynStream devices performed best in our roundup overall due to their superior proprietary software, but Colorado's QFA500—with hardware data compression enabled—turned in the fastest times for two of our tests. Most systems, however, had similar results because of the almost standard SY-TOS; its sibling, Sytos Plus, although more full-featured, tended to slow things down.

The **Full Disk Backup** test measures the time it takes to perform a file-by-file backup of the entire disk's contents. Typically, this is the first function performed after installing the tape system.

The **Full Disk Restore** test measures the time needed to perform a file-by-file restore of the tape's contents after the Full Disk Backup. This function is typically performed after replacing a faulty hard disk with a new one.

The **Directory Backup** test measures the time it takes to perform a file-by-file backup of one 29MB directory tree. This simulates periodic selective backup of program and data files.

The **Directory Restore** test measures the time required to perform a file-by-file restore of the tape's contents after the Directory Backup test. This would usually be done to recover archived program and/or data files.



All tape systems were tested on a Compaq Deskpro 386/25 with 2MB of RAM, a VGA display, and a 300MB ESDI hard disk. All hard disks were formatted using Compaq DOS 4.01 and partitioned as one physical 300MB partition (drive C:). The file system, which each tape drive had to back up and restore, was created with the PC Labs Data Generator—it creates sequential and random files in both binary and ASCII format. The file structure consisted of several hidden files (in addition to the system files), two hidden subdirectories, read-only files, zero-byte files, and two 7MB files (typical of high-resolution color bitmap files). The directory structure consisted of 14 subdirectories off the root of the C: drive, with two subdirectories going seven levels deep. The total file structure before installation of the tape drive software was 118,181,088 bytes, as reported by CHKDSK.

Before each backup and restore, the hard disk was reformatted and DOS files were put on the disks. The backup software for each tape system was also installed using the default settings as suggested by the manual and/or installation software. In addition, before each backup, the file system was created using the Data Generator. All byte counts and file comparisons were made using DOS CHKDSK.

Tests were performed in the foreground using the provided software's program shell. All timings were done manually with a digital stopwatch. The timings began at the last keypress to start a procedure and ended when keyboard control was returned to the program shell. Times are reported in minutes and seconds.

COMPAQ COMPUTER CORP.

150/-250- Megabyte Tape Drive

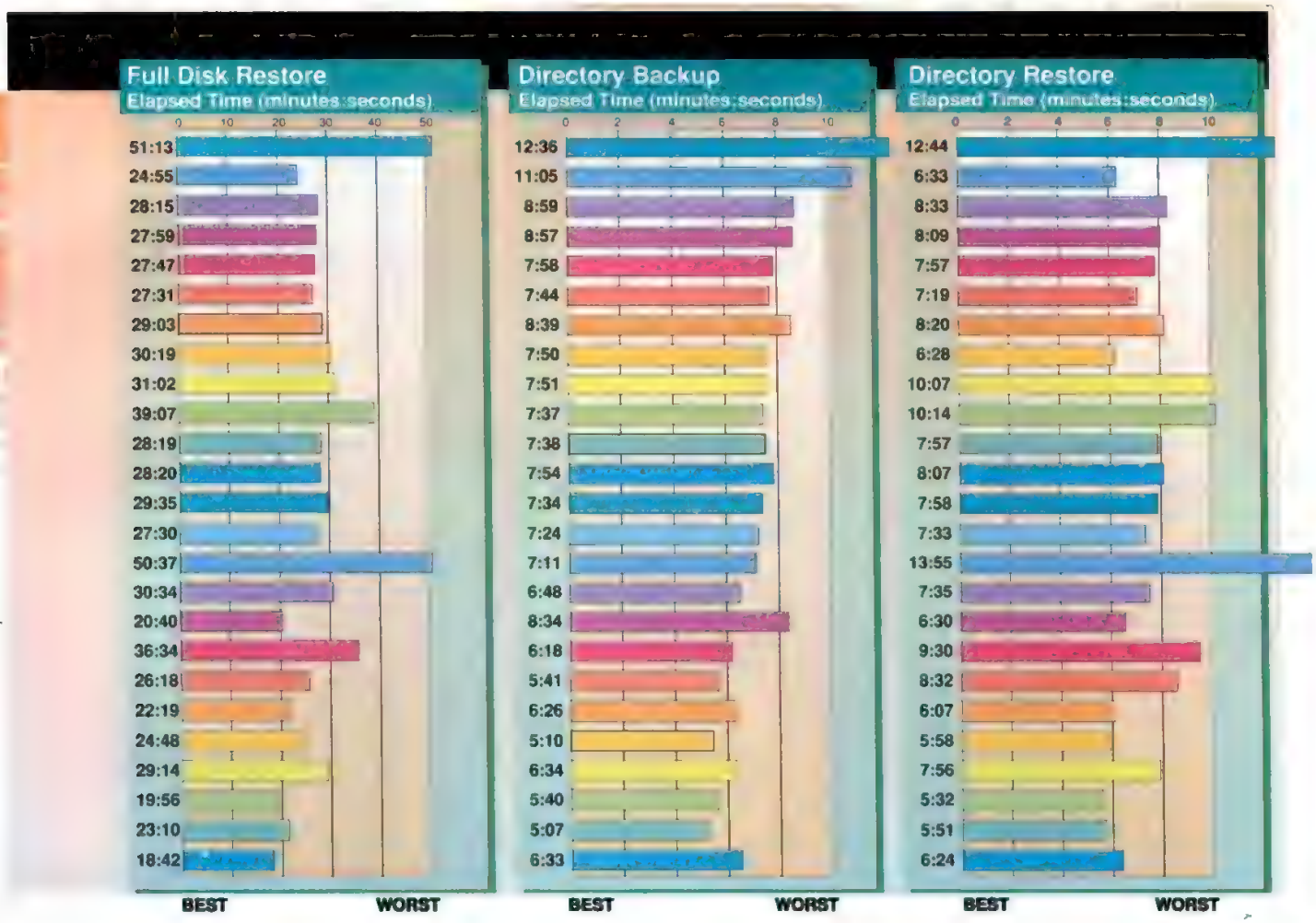
by M. David Stone

Tape backup systems are meant to prevent headaches, not cause them. So, at minimum they ought to be plug-and-play devices. Compaq's 150/-250- Megabyte Tape Drive is one of the few that is. Aimed primarily at Compaq computer owners who are willing to pay a premium for a Compaq solution, the device is available only as an internal half-height drive, and carries a hefty list price of $1,999. Even the unit's warranty is defined to either match the warranty for the Compaq system in which it's installed, or run 90 days, whichever is longer.

As its name implies, the Compaq drive supports both standard-length (150MB) and extended-length (250MB) cartridges. Like many of its competitors, the drive uses Sytron's *SY-TOS* tape backup software, which affords it quick file access and lets it work with Novell *NetWare 286*-based and 3Com networks. Unlike many other systems, however, the Compaq drive comes with two versions of *SY-TOS*: version 3.11 for DOS and version 1.11 for OS/2. The manufacturer of the drive we tested was Wangtek.

PLUG-AND-PLAY OPERATION

Even if you're not comfortable with installing hardware, you should be able to handle this installation easily thanks to Compaq's heavily illustrated manual. Plug the 8-bit Compaq QIC-24 interface board into an empty slot in your PC, mount the drive in a 5.25-inch, half-height drive bay, connect the supplied power cable to the drive and the motherboard, and connect



CONTINUES

the signal cable between the drive and the interface board. DIP switches let you select IRQ, DMA channel, and base address on the interface board, but in most cases you can simply use the factory settings. However, if you already have many boards installed in your system, you may find that the somewhat limited choice of settings—to IRQ 3 or 5, and to a base address of 200 or 300—may make it difficult to avoid a conflict.

Installing *SY-TOS* is even easier than installing the hardware. Simply start the installation module, designate a drive and directory to use, and let *SY-TOS* install the program. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for the full scoop on *SY-TOS*.)

On the PC Labs performance tests, the Compaq system took about 27.5 minutes for the full-disk File-by-File Backup test, and about 29 minutes to restore that data. Times for *SY-TOS*'s modified image feature were a little slower: about 29.5 minutes for an image backup of the entire disk and about 29 minutes for the image restore. Compaq's entry took about 8.5 minutes to complete each of the PC Labs single directory backup and restore tests. These results place the system on the slow side of average, but still within the expected performance range.

Overall, Compaq's unit is a well-designed product that does what it promises. Its list price is a little steep, but not out of line with those of other well-known brands. You can get the same functionality elsewhere for far less—but not if you're looking for the Compaq imprint.

FACT FILE

150/-250- Megabyte Tape Drive
Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; (800) 231-0900, (713) 370-0670.
Software: *SY-TOS* 3.11 for DOS and *SY-TOS* 1.11 for OS/2.
List Price: Internal drive, ISA board, $1,999 (with software).
Requires: Compaq DOS 3.0 or later, 512K RAM.
In Short: A plug-and-play internal unit that's aimed primarily at Compaq users. Its steep list price includes both an OS/2 module as well as the usual DOS version of *SY-TOS*.

CIRCLE 607 ON READER SERVICE CARD

CORE INTERNATIONAL INC.

COREtape CT150/250E

by Bruce Brown

CORE International has a reputation for building fast hard disks. PC Labs' performance tests show the company can

PERFORMANCE TESTS: TAPE BACKUP

With a few notable exceptions, the tape drives in this roundup offer the same general level of performance. Since the majority of these drives employ an 8-bit QIC interface for the PC, any differences in the test times are due primarily to the backup software used to control the unit.

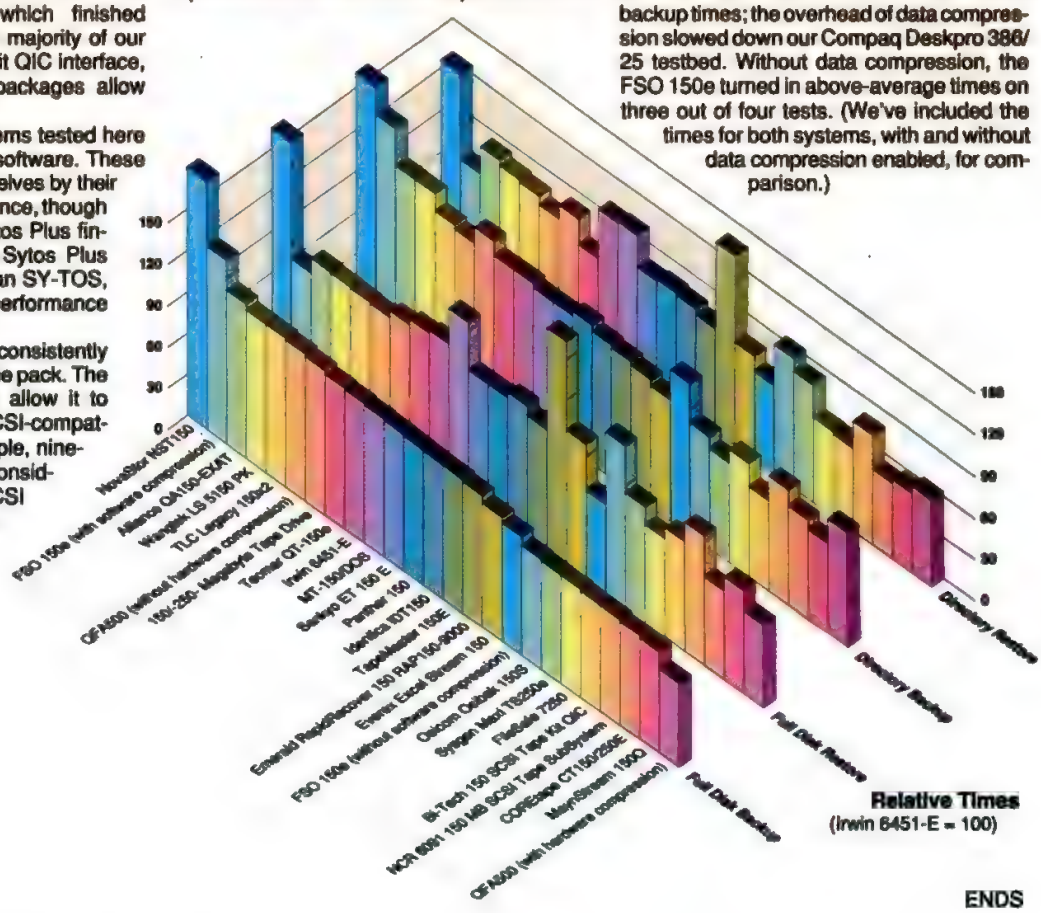
The best overall performers in the bunch were the MaynStream 150Q and the COREtape CT150/250E, which finished among the top three on the majority of our tests. While both use an 8-bit QIC interface, their proprietary software packages allow more efficient control.

The majority of the systems tested here use SY-TOS or Sytos Plus software. These systems distinguished themselves by their middle-of-the-pack performance, though the three systems using Sytos Plus finished at the bottom; while Sytos Plus may have more features than SY-TOS, these features come with a performance penalty.

The NovaStor NST150 consistently finished near the bottom of the pack. The hooks in the software that allow it to exchange data with other SCSI-compatible tape systems (for example, nine-track tape) slowed it down considerably, despite its 16-bit SCSI interface and Tandberg drive mechanism.

The fastest tape system on the Full Disk Backup and Restore tests was Colorado Memory Systems' QFA500 drive with hardware data compression. Because data compression reduces the amount of data being written to the tape, overall tape system throughput is increased. In the case of the QFA500, it took 40 percent less time to back up our test files with data compression than without. Without data compression enabled, the QFA500 was merely average.

We also tested the Tallgrass Technologies FSO 150e with and without data compression. The FSO 150e differs from the QFA500 in that its data compression is performed in software rather than hardware. With software data compression enabled, the FSO 150e turned in the second-slowest backup times; the overhead of data compression slowed down our Compaq Deskpro 386/25 testbed. Without data compression, the FSO 150e turned in above-average times on three out of four tests. (We've included the times for both systems, with and without data compression enabled, for comparison.)



ENDS

build speedy tape-drive systems as well. Its $2,295 external COREtape CT150/250E delivered some of the best performance times we saw.

Proprietary software, namely *COREtape* version 2.0, is almost all that differentiates CORE's entry from other tape backup systems. Otherwise, the COREtape CT150/250E package we looked at uses standard parts: a 3.25- by 6- by 10.75-inch (HWD) Archive tape drive and an Everex QIC 02 ISA interface board. Since the drive draws its power from your PC, it doesn't have to house its own power supply and fan and, thus, doesn't need a lot space on your desk. CORE also offers an external version of the drive with an MCA board for $2,295 and an internal drive with an ISA board for $1,995.

JUST ONE MANUAL

Installing the 8-bit interface board and tape drive isn't difficult. After you've inserted the board into an empty slot, simply plug a power connector into the board, and then attach a cable between the board and the tape drive. You'll only have to refer to one manual to learn all about the system's components (including software), which is an advantage over other units that force you to refer to separate documentation for the board, the drive, and the software.

As its name suggests, the COREtape CT150/250E can handle both standard-length and extended-length tapes, capacities that should suit the needs of power users and small-network managers alike. Supported networks include those running Novell *NetWare 286*, *NetWare 386*, as well as those from 3Com. A forthcoming version of *COREtape* will work in OS/2 protected mode and provide data compres-

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sion capabilities. The unit does not offer quick file access.

Regardless of what features will be included in the next release, *COREtape* already does a fine job. Its menu-driven system for choosing program functions, files, and directories makes backing up and restoring data a breeze. *COREtape* has just about all the standard functions you'd expect, including automatic backup, batch-mode, DOS command-line operation, and automatic unattended backup for networks.

But where the CT150/250E really makes its mark is in performance. The unit completed PC Labs' Image Backup test in about 21.5 minutes, and performed the Image Restore test in 20.5 minutes. It took just under 20 minutes to finish our File-by-File Backup test, and about the same amount of time to restore that data to the disk.

Speed doesn't come cheap: the COREtape CT150/250E is among the more expensive units we tested. You can save $300 by opting for the internal unit—if you have a spare drive bay. But whichever you choose, you'll find that the COREtape is a fine system.

FACT FILE

COREtape CT150/250E
CORE International Inc., 7171 N. Federal Highway, Boca Raton, FL 33487; (407) 997-6055.
Software: Propretary.
List Price: External drive, ISA or MCA board, $2,295 (external with power supply, $2,475); internal drive, ISA board, $1,995.
Requires: DOS 2.0 or later, 256K RAM.
In Short: The external COREtape CT150/250E package features an Archive tape drive an Everex QIC 02 interface board. Its list price is on the high side, but its performance is among the fastest.

CIRCLE **608** ON READER SERVICE CARD

EMERALD SYSTEMS CORP.

Emerald Systems RapidRecover 150 Model RAP150-9000

by Bill O'Brien

You can't judge a tape drive by its casing, especially when one unit looks pretty much like the next. But if the $2,295 (including ISA SCSI board) external Emerald Systems RapidRecover 150 drive, model RAP150-9000, we tested is visibly undistinguished, its software is anything but ordinary.

In addition to this package, Emerald offers an internal ISA system for $1,795 and an external MCA system for $2,195. All these systems can accept standard-length (150MB) and extended-length (250MB) tapes. Software, which is the key here, is extra.

Along with the 3.5- by 8.5- by 10.5-inch (HWD) Emerald drive and 8-bit Emerald board, the company sent *EmSAVE*, *EmQ*, and *EmLIB*—its DOS, Novell *NetWare 286* and *386*, and tape-library management software, respectively. *EmSAVE*, the *Windows*-based program we used in testing, costs $495 and comes with five blank tapes. It provides automatic, batch-mode, and command-line operation and supports modified image backups and restores. *EmQ* lists for $1,295, including five blank tapes. *EmLIB* carries a list price of $395, but is well worth the cost if you plan to have a tape library of any size.

FAILED ATTEMPTS

Installing *EmSAVE* version 1.50 is so deceptively simple that you might not realize things haven't gone right until you try to use the program. At least that was our experience when we failed to correctly install the program—twice.

The first time we tried to run *EmSAVE* on our Compaq DeskPro 386/25, which was equipped with *Windows 386*, we were greeted with an Out of Memory dialog box. Since our Compaq Deskpro 386/25 had 4MB of memory, we questioned the validity of that error message.

Next, we reinstalled the program under the runtime version of *Windows* that Emerald Systems provides with *EmSAVE*. (The runtime version uses the kernels from *Windows 286*). This time, *EmSAVE* loaded correctly but displayed a SET EMSPATH error box. Apparently, the installation routine does not modify the CONFIG.SYS file to include this environment command; without it the program will not run.

The installation procedures covered in the manual do not directly address the EMSPATH environment variable. But you will find an entry for it in the index and an explanation in the chapter preceding the one on software installation. It's to Emerald's credit that this subject is covered in the manual. But $395 software for a $2,095 tape drive should do everything short of loading and unloading the tape cartridge.

Emerald's *EmSAVE* is credible, but the hot ticket for the RapidRecover 150, model RAP150-9000, is *EmQ*, its network software. With unattended backup and node as well as server backup capabilities, the program will automate the entire network protection process. All of that functionality adds $800 to the cost of the backup system—money well spent, if that's what you need.

FACT FILE

Emerald Systems RapidRecover 150 Model RAP150-9000
Emerald Systems Corp., 12230 World Trade Dr., San Diego, CA 92128; (800) 767-7267.
Software: Proprietary.
List Price: External drive, ISA board, $2,095, internal drive, ISA board, $1,795, external drive, MCA board, $2,195, *EmSave* software with five blank tape cartridges, $495 ($395 without tape); *EmQ* (Netware) software with five blank tapes, $1,295 ($1,195 without tape); *EmLib* tape management software, $395
Requires: DOS 3.2 or later, 640K RAM
In Short: Despite the high price of its *Windows*-based software (and some installation quirks), Emerald has done a good job of bringing tape backup into a GUI environment.

CIRCLE **609** ON READER SERVICE CARD

SLOW RESTORES

On the PC Labs backup tests, the RapidRecover 150's performance was average—about 25 minutes for the file-by-file backup and about 7 minutes for the directory backup. Its restore times—about 50.5 minutes on the file-by-file test and under 14 minutes for the directory test—were among the longest of the drives we tested. The system does not offer quick file access.

There are at least two schools of thought about restores and restore times. One of them is that a restore is something you hope you never have to do; but as long as restoring data from tape takes less time than recomposing it manually, you're still ahead of the game.

The other school says speed counts. In the case of Emerald's RapidRecover 150, the tradeoff for speed is the company's experience with tape backup drives and software, its technical support line (which proved faultless in our experience), and its quick response to problems—all of which justify the price Emerald is asking for the system.

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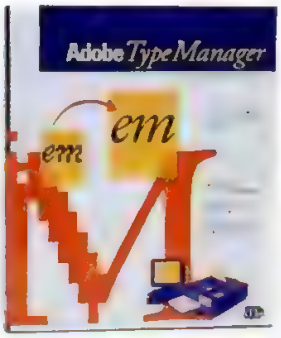

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Flight Simulator 4.0 ..... 38.
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PC Globe 3.0 ..... 36.
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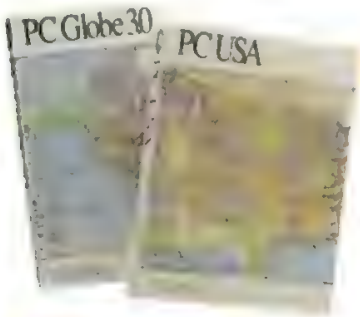

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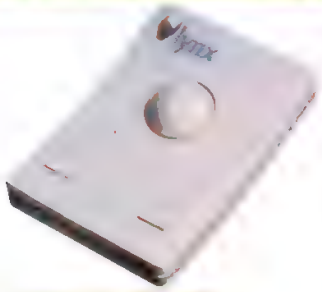

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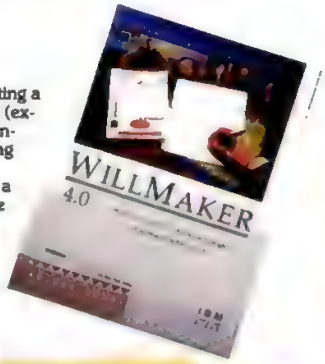

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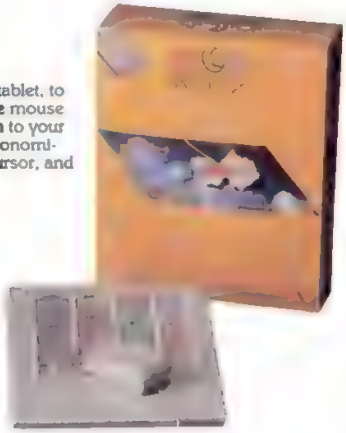

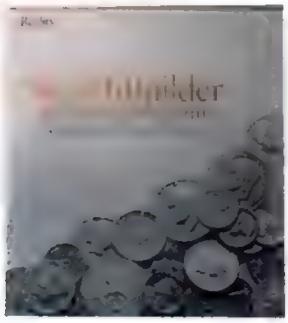

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Virgin Mastertronic
Clue ..... 23.
Monopoly ..... 23.
Scrabble ..... 23.

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3-G Graphics
Images with Impact ..... 59.
Adobe
Adobe Type Manager ..... 59.
Aldus
★ Pagemaker 3.01 ..... 499.
ArtRight
★ ArtRight Images Vol. 1 or 2 ..... 110.
AutoDesk
★ AutoDesk Animator ..... 229.
Bitstream
Collections ..... Call.
FaceLift ..... 58.
Headlines ..... Call.
Bourbaki Inc.
Fractool ..... 29.
Brightbill-Roberts
Show Partner F/X 3.5 ..... 224.
Broderbund
Bannermania ..... 21.
Caere Corporation
★ Omnipage 2.0 386 ..... 589.
Corel Systems
★ CorelDRAW! 1.2 ..... 319.
Custom Applications
★ Freedom of Press ..... 249.
Digital Research
GEM Artline ..... 269.
GEM Presentation Team 1.1 ..... 279.
Logitech
Catchword ..... 110.
Lotus
Freelance Plus 3.0 ..... 339.
Micrografx
★ Designer 3.0 ..... 469.
★ Charisma ..... 344.
Micrologic
More Fonts ..... 89.
Microsoft
★ Powerpoint for Windows ..... 319.
PC Publishing
Impress ..... 74.
Power Up Software
Express Publisher 1.1 ..... 83.
Software Publishing
Harvard Graphics 2.13 ..... 309.
PFS: First Publisher 3.0 ..... 95.
Timeworks
Publish-It! ..... 106.
Publish-It Lite! ..... 33.
T/Maker
ClickArt EPS Business Art ..... 80.
ClickArt Business Cartoons ..... 42.
Unison World
Avagio ..... 169.
WordPerfect
DrawPerfect ..... 269.
Xerox
Gray F/X ..... 258.
Ventura Publisher 2.0 ..... 519.
Ventura Publisher Gold Series 3.0 519.
Zenographics
Pixie 2.0 ..... 165.
Z-Soft
★ PC Paintbrush IV Plus ..... 109.

CAD PRODUCTS

American Small Business Co.
Design CAD 3D 3.0 ..... 399.
AutoDesk
Autosketch 2.0 ..... 95.
ComputerEasy Software
Dream House Professional ..... 47.
Floorplan ..... 26.
Foresight Resources
★ Drafix Windows CAD ..... 435.
Generic Software
Basic Home Design ..... 31.
Generic CAD 3D Drafting ..... 179.
Generic CAD Level 3 w/ Dot Plot ..... 209.
Mathsoft
Mathcad 2.5 ..... 293.
Summagraphics
Summasketch Plus ..... 399.

BUSINESS

Above Software
Above Disk 3.0 ..... 59.
Absolute Solutions
★ Computerized Classic Acct. ..... 209.
Alpha Software
Alpha 4 ..... 299.
Ashton Tate
Control Room ..... 72.
dBASE IV ..... 479.
Avery
LabelPro ..... 49.
List & Mail Plus ..... 38.
Bloc Publishing
Form Filler 2.0 ..... 84.
Form Tool Gold ..... 56.
Pop Drop Plus ..... 56.
Blythe Software
Omnis 5 ..... 410.
Borland International
Paradox 3.0 ..... 445.
Paradox 386 ..... 579.
Quattro Pro ..... 295.
Brightbill-Roberts
HyperPAD 2.0 ..... 83.
Broderbund
MemoryMate 3.01R ..... 38.
Button Ware
PC File 5.0 ..... 72.
Central Point Software
Copy II PC 5.0 ..... 22.
★ PC Tools Deluxe 6.0 ..... 85.
CE Software
Quickmail ..... 43.
Checkfree Technologies
Checkfree Express 2.0 ..... 19.
Chronologic Corp.
Instant Recall ..... 64.
Chronos
Who What When 2.0 ..... 172.
Contact Software Int'l
ACT! ..... 219.
Crosstalk Comm.
★ Crosstalk for Windows 1.0 ..... 117.
Crosstalk MK 4 2.0 ..... 130.
Remote 2 2.0 ..... 107.
Dac Software
Dac Easy Accounting 4.1 ..... 79.
Dac Easy Bonus Pak 4.0 ..... 159.
Dariana Technology
System Sleuth ..... 83.
Datastorm Tech.
Hot Wire ..... 68.
Procomm Plus 1.1 ..... 59.
Delrina Technologies
PerFORM 2.1 (w/Rebate) ..... 129.
★ PerFORM PRO ..... 269.

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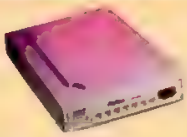

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Dow Jones & Company
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Market Analyzer 2.0 ..... 189.
Dynamic Microprocessor Assoc.
pcAnywhere III IV ..... 65.
Enable Software
Enable BP ..... 110.
Enable/OA ..... 409.
Fifth Generation
Fastback Plus 2.09 ..... 99.
Mace Utilities 1990 ..... 85.
Extra ..... 54.
FormalSoft
ProQube 1.03 ..... 59.
FormGen Corp.
FormGen Plus 5.0 ..... 106.
Formworx Corp.
Form Publisher for Windows ..... 139.
Formworx with Fill & File 2.5 ..... 80.
Fox Software
Foxbase + Dev. Sys. 2.1 ..... 185.
FoxPro ..... 469.
FoxPro LAN ..... 639.
Funk Software
Allways 1.0 ..... 80.
P.D. Queue ..... 54.
Sideways 3.21 ..... 37.
Gazelle Systems
Optune 1.2 ..... 49.
Gibson Research
Spinrite II ..... 69.
Great American Software
One-Write Plus Account Systems . 165.
hDC Computer Corp.
★ FirstApps ..... 49.
★ Windows Express ..... 49.
Helix
Headroom 2.1 ..... 72.
IBM
Current ..... 355.
Informix
Wingz ..... 329.
Inset Systems
HiJaak 2.0 ..... 98.
Intuit
Quicken 3.0 ..... 35.
Lattice, Inc.
Lattice C 6.0 ..... 155.

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Lord Publishing
Ronstadt's Financials ..... 99.
Lotus
Agenda 1.01 ..... 259.
Lotus 1-2-3 Rel. 2.2 ..... 339.
Lotus 1-2-3 Rel. 3 ..... 409.
Lotus 1-2-3 Upgrade Kit ..... 129.
Magellan 2.0 ..... 109.
Symphony 2.2 ..... 529.
Magee
AutoMenu ..... 33.
Meca
Home Lawyer ..... 76.
Managing Your Money 6.0 ..... 116.
Merril & Bryan
InfoSpotter ..... 50.
Turbo EMS ..... 49.
Metro Software
Lasertwin All In One ..... 112.
Microcom
Carbon Copy Plus 5.2 ..... 105.
Relay Gold 4.0 ..... 161.
Micro Logic
InfoSelect ..... 54.

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Microrim
R:Base Compiler ..... 579.
R:Base for DOS 3.0 ..... 456.
Microsoft
★ Excel for Windows 2.1 ..... 299.
★ Project for Windows 1.0 ..... 455.
★ Windows 3.0 ..... 88.
Windows Developer's Tool Kit ..... 319.
Word 5.0 ..... 205.
★ Word for Windows ..... 309.
Works 2.0 ..... 89.
Mosaic Marketing
Twin Level III ..... 123.
Multisoft
PC-Kwik Power Disk ..... 46.
PC-Kwik Powerpak 1.5 ..... 70.
Super PC-Kwik 3.3 ..... 49.
New England Software
Graph In The Box Executive ..... 159.
Nolo Press
Willmaker 4.0 ..... 34.
Norton Lambert
Close Up Customer/Terminal ..... 119.
Close Up Support/ASC ..... 154.
OCR Systems
Read Write ..... 349.
Patton & Patton Software
Flow Charting II+ ..... 129.

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Peachtree Complete III ..... 139.
Peachtree Cmpl. III Bonus Bdle ..... 219.
Peter Norton Computing
Norton Util. Advanced 5.0 ..... 109.
Norton Commander 3.0 ..... 85.
The Norton Backup 1.0 ..... 95.

Power Up Software
Calendar Creator Plus ..... 39.
Name That Disk ..... 32.
Top Priority ..... 58.
Precision Software
★ Superbase 4 Windows ..... 399.
Prime Solutions
Disk Technician Advanced 6.0 ..... 88.
Disk Technician Professional ..... 36.
Primetime Software
Primetime Personal ..... 68.
Prodigy
Prodigy Start Up Kit ..... 29.
QMS
★ Ultrascript PC 2.1 ..... 129.
★ Ultrascript PC Plus 2.0 ..... 256.
QuadBase Systems
QuadBase-SQL 1.0 ..... 695.
Qualitas
386Max Professional ..... 75.

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DESQview for Clipper ..... 279.
DESQview 386 2.3 ..... 119.
QEMM 386 5.1 ..... 55.
QRAM ..... 45.
Reality Technologies
Wealthbuilder (by Money Mag.) ..... 135.
Reference Software
Grammatik IV 1.0 ..... 49.
Rightsoft
Rightwriter 4.0 ..... 49.
Rinearson Support Assoc.
Microsoft Word Companion Disk ..... 29.
Rupp Corp.
FastLynx 1.01 ..... 119.
Samna
★ Ami Professional ..... 305.
Softlogic Solutions
Software Carousel ..... 55.
Softview
it:X Business Expense Reports ..... 49.
Software Publishing
PFS: First Choice 3.02 w/Prodigy . 105.
PFS: Preface ..... New.
Professional Write 2.1 ..... 139.
Solution Systems
Brief 3.0 for DOS ..... 159.
Spinnaker Software
BetterWorking Eight-In-One ..... 35.
Splash ..... 56.
SYBIZ
Service Industry Accounting 2.0 ..... 295.
Symantec
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Backup Pro ..... 37.
Office Manager ..... 29.
Timeslips Corp.
PercentEdge ..... 59.
Timeslips III 3.4 ..... 165.
Tops
Tops Network Bundle for DOS ..... 286.
Touchstone
Check It! ..... 82.
Traveling Software
Laplink III ..... 85.
Vertisoft
Double Disk ..... 60.
Visionary Software
Synchronicity ..... 36.
West Lake Data
Pathminder + ... 76.
Westlake Value Pak ..... 64.
White Crane Systems
AutoImport 1.11 ..... 89.
WordPerfect Corp.
PlanPerfect 5.0 ..... 258.
WordPerfect 5.1 ..... 249.
WordStar U.S.A.
WordStar 6.0 ..... 256.
XTree Company
XTree Pro Gold ..... 69.
Xerox
Formbase ..... 324.

LANGUAGES

Asymetrix
Toolbook ..... 295.
Borland International
Turbo C Prof. 2.0 ..... 164.
Turbo Pascal Prof. ..... 169.
Maxem Publishing
Cause ..... 199.
Effect ..... 75.
Microsoft
Basic Prof. Dev. Sys. 7.0 ..... 329.
C Compiler 6.0 ..... 289.
Quickbasic 4.5 ..... 65.
QuickC 2.0 ..... 63.
Peter Norton
Norton Editor 1.3 ..... 47.

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CIRCLE 225 ON READER SERVICE CARD

EVEREX SYSTEMS INC.

Everex Excel Stream 150

by Bruce Brown

In addition to the Everex Excel Stream 150, you'll see the Everex Systems name on the interface boards of five other packages reviewed in this roundup. For its own $1,899 system (as reviewed), Everex uses not only its QIC 02 ISA board, but also its proprietary *Streaming Tape ST-408* backup software. An external Wangtek tape drive completes the picture.

The 5.5- by 7- by 15.5-inch (HWD) external tape drive isn't the only one Everex offers. The vendor sells an internal drive with an ISA interface board for $1,699; an external drive with an MCA board for $2,099; and an internal drive with an MCA board for $1,899. All of these accept standard-length (150MB) and extended-length (250MB) tapes.

FACT FILE

Everex Excel Stream 150
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (800) 821-0806, (415) 498-1111.
Software: Proprietary.
List Price: External drive, ISA board (with both software packages), $1,899; internal drive, ISA board (with both software packages), $1,699; external drive, MCA board (with both software packages), $2,099; internal drive, MCA board (with both software packages), $1,899.
Requires: DOS 2.1 or later, 256K RAM.
In Short: The current version of the Excel Stream 150's software won't make image backups of hard disk partitions greater than 32MB under DOS 4.01, but a fix is in the works. Otherwise, this system's software configuration help and scheduling module make this unit easy to install and to use.

CIRCLE 610 ON READER SERVICE CARD

Installing the Everex Excel Stream 150 is about as easy as it gets—Everex designed the 8-bit interface board and wrote the software, and the system seems better integrated than many that use components from different manufacturers. Also, Everex's fine manual pays a lot of attention to hardware installation, and includes line drawings that walk you through the steps for installing both ISA and MCA interface cards.

GRAPHICAL SETTINGS

If you're already familiar with Sytron's *SY-TOS*, you can use that program instead of Everex's *Streaming Tape ST-408* backup software, according to the vendor. But even if you've worked with *SY-TOS*, you'll probably find that *Streaming Tape ST-408*'s configuration module is worth a look. *Streaming Tape ST-408* displays a graphical representation of your interface board's jumpers and switches, and it also shows you how to change them in case the default DMA, IRQ, and memory address settings aren't right for your PC—which is a helpful touch. Another useful module, the *Everex Scheduler*, allows the system to perform automatic backups and other timed tasks.

All of *Streaming Tape ST-408*'s functions are accessible through menus; the package offers batch and DOS command-line modes as well. Supported networks include those running Novell *NetWare 286*, *NetWare 386*, *3Com*, and *Banyan*. Quick file access is not a feature of the system.

The only glitch we found is that the current version of the software can't be used for image backups of drive partitions larger than 32MB on systems using DOS 4.*x*. According to Everex, a fix is in the works. But since our test systems used DOS 4.01, we were only able to run the PC Labs file-by-file backup and restore tests and the directory backup and restore tests. On the former pair of tests, the Everex's times were about 24 minutes and 30.5 minutes, respectively. On the latter pair, its scores were under 7 minutes and 7.5 minutes, respectively.

The Everex software's configuration Lmodule gives the system an edge in usability. Compatibility with *SY-TOS* gives the system an edge in familiarity. And support of many popular networks gives it an edge in connectivity. All three make the Excel Stream 150 a highly recommended selection.

IDENTICA/DIVISION OF PRIMA INTERNATIONAL INC.

Identica IDT150

by Bruce Brown

Standard components, predictable performance, and a reasonable price are the hallmarks of Identica's $1,325 IDT150, which, as reviewed, includes a 3.75- by 5.75- by 13-inch (HWD) external tape drive (drive mechanics are by Sankyo Seiki, electronics by Identica), an Everex ISA interface board, and version 3.0 of Sytron's *SY-TOS* backup software.

A network as well as a single-user device, the Identica IDT150 supports LANs running Novell *NetWare 286*, *NetWare 386*, 3Com, and Banyan, among others. As alternatives to *SY-TOS*, Identica also sells its tape drive with Emeritus Software's *TapeWare* or NovaStor's *NovaBack* (for more information on *NovaBack*, see the review of the NovaStor NST150 later in this story). With *TapeWare*, a *NetWare 286* value-added process, you can directly connect the drive to a file server and issue a command from any workstation to backup the server.

FACT FILE

Identica IDT150
Identica/Division of Prima International Inc., 3350 Scott Blvd., Bldg. 7, Santa Clara, CA 95054; (408) 727-2607.
Software: *SY-TOS* version 3.0; *TapeWare* (for DOS and Novell).
List Price: External drive, ISA board (with software), $1,450 (without software, $1,325); internal drive, ISA board (with software), $1,450; external drive, MCA board (with software), $1,555.
Requires: DOS 2.1 or later, 512K RAM.
In Short: No surprises, no sorrows. The Identica IDT150 offers average performance and standard components—a Sankyo Seiki/Identica external tape drive, an Everex QIC 02 interface board, and Sytron's *SY-TOS*—at a competitive price.

CIRCLE 611 ON READER SERVICE CARD

In addition to a choice of software, Identica offers you several hardware configurations: an internal tape drive with an ISA interface board ($1,450) and an external drive with an MCA board ($1,555). All of these will handle standard-length (150MB) and extended-length (250MB) cartridges.

EXTERNAL POWER

Like many external tape drives, the IDT150 houses its own power supply. And, again like many systems, the IDT150's installation procedures are straightforward. But in the event that the 8-bit QIC-02 board's settings aren't configured properly for your PC straight out of the box, the documentation will tell you everything that you need to know about changing DMA channels or IRQs on the board and in the software.

The *SY-TOS*-equipped IDT150 works

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CIRCLE 244 ON READER SERVICE CARD

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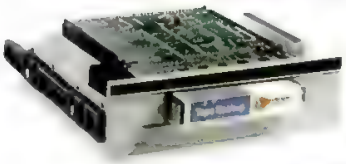

Jumbo also offers an unattended scheduler for backing up at night or on weekends. And it's fully network compatible with Novell,® 3COM,® PC Net,® and optional Xenix®/UNIX® support. Everything is rated high with Jumbo except one–the price! You still get it for an incredibly low price.

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CIRCLE 473 ON READER SERVICE CARD

like every other system that uses this industry-standard software. You can use menus, single DOS commands, or batch files to run the system. Data compression is not an option, nor is quick file access. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*.")

In keeping with other systems that use *SY-TOS* and the QIC 02 interface board, the Identica IDT150 turned in average performance times on PC Labs' tests. It took 25.5 minutes to complete the file-by-file backup of the entire disk, and about 29.5 minutes—a bit slower than average—to restore that data to disk. It completed our image backup and restore tests in just under 26 minutes and 25 minutes, respectively, and our directory backup and restore tests in 7.5 minutes and just under 8 minutes, respectively.

Average performance and standard parts aren't exciting, but get the job done. And that's exactly what the Identica IDT150 has to offer at a competitive price.

IRWIN MAGNETIC SYSTEMS INC.

Irwin 6451-E

by M. David Stone

Irwin Magnetic Systems Inc. says that it's the world's largest supplier of minicartridge tape backup systems for PCs. Although the Irwin 6451-E uses a DC 600 cartridge rather than a minicartridge, the quality of this $1,975 package helps explain Irwin's success.

Part of the company's 6000 series of drives, the Irwin 6451-E package includes an Everex ISA interface board, version 2.1 of Irwin's *EzTape* software, Fresh Technology's *MAP Assist* utility, and an external 2.5- by 6.5- by 14-inch (HWD) Irwin tape drive. Other 6000 series systems include an internal unit with an ISA board ($1,575), an external unit with an MCA board ($2,025), and an internal unit with an MCA board ($1,625).

Like many of the devices reviewed here, the Irwin 6451-E offers quick file access, and can handle both standard-length and extended-length cartridges—but with a slight twist: the storage capacity of standard-length tapes is 155MB rather than 150MB, according to Irwin.

To install the hardware, simply insert the 8-bit QIC 36 interface board into an available slot in your PC, connect the cable between the board and the drive, and plug the power cord into the drive.

Irwin's *EzTape* software includes an installation program that asks for a drive and directory to install to, then copies three floppy disks full of files to your hard disk. The program also offers a hardware installation option that lets you match the software settings to the IRQ, DMA, and address settings on the board. Although normally the factory settings of the interface board match the default settings of the software when they are shipped, this was not the case with our review unit, which complicated installation.

EZ-TO-USE SOFTWARE

EzTape is admirable for its simplicity. To back up a hard disk, simply choose Backup from the main menu, then choose Backup All Files or Select Files to Backup. You can also create one or more definition files to back up groups of files on a regular basis. Restoring files is equally simple. Choose Restore from the main menu, and you can restore all files, select a particular file or set of files for restoration, or create a definition file for repeated use.

Other options let you erase or retension a tape; display tape information, such as volume name; and set up times for automatic backup or restoration. *EzTape* does not offer image backup, but if you need this feature, you can use the hardware with Sytron's *SY-TOS* (as well as with other software designed for the QIC 36 interface), according to the vendor.

EzTape will support Novell *NetWare 286* and *NetWare 386*, 3Com networks, and IBM *PC LAN* environments. If you're a *NetWare* user, you will be particularly interested in *MAP Assist*—this package will let you backup an entire Novell network from a workstation.

The Irwin 6451-E completed the PC Labs File-by-File Backup test in about 26 minutes, and restored that data to the hard disk in about 31 minutes. It took about 8 minutes to complete the Single Directory Backup test, and about 10 minutes to restore the directory to the disk. Although these times are somewhat slow, they fall well within the expected range for this class of drive.

At $1,975 with a one-year warranty and widely available at a discount, the Irwin 6451-E is a credible choice for both power users and small-network managers. Its somewhat slow performance is made up for by its *EzTape* software, which makes this system more than a commodity item.

FACT FILE

Irwin 6451-E
Irwin Magnetic Systems Inc., 2101 Commonwealth Blvd., Ann Arbor, MI 48105; (800) 421-1879, (313) 930-9000.
Software: Proprietary.
List Price: External drive, ISA board (with software), $1,975; internal drive, ISA board (with software), $1,575; External drive, MCA board, $2,025; internal drive, MCA board, $1,625.
Requires: DOS 2.1 or later, 512K RAM.
In Short: The 6451-E includes an Irwin tape drive, an Everex interface card, and Irwin's own straightforward *EzTape* software. Its somewhat slow performance is more than compensated for by its ease of use.

CIRCLE 612 ON READER SERVICE CARD

MAYNARD INC.

MaynStream 150Q

by M. David Stone

One of the more familiar names in backup systems, Maynard Inc. is a corporate relative of Irwin Magnetic Systems. But although both are divisions of Archive Corp., a manufacturer and supplier of data storage products, they maintain distinctly different product lines. Maynard's MaynStream 150Q system uses an Archive drive, a Maynard QIC-02 board, and Maynard's *MaynStream* version 3.0 software—none of which matches any part of the Irwin 6451-E package that's also reviewed in this article.

The MaynStream 150Q comes with either an external ($2,195) or internal ($1,895) drive and either an ISA or EISA interface board, or it can come with an external ($2,295) or internal ($1,995) drive and an MCA board. We tested an external drive with an ISA board. Maynard calls the 3.75- by 6.5- by 15-inch (HWD) drive a portable, and provides a handle to carry the unit from PC to PC.

Like most of the systems we evaluated, the Maynard 150Q can handle standard-length (150MB) and extended-length (250MB) tapes. Unlike many, it does not include quick file access. However, a Catalog feature can speed data restoration by quickly identifying the proper tape and backup set for any given file. Maynard expects to add true quick file access in the next version of its software, which should be available by year's end.

A MINOR GLITCH

To install the device, you plug the 8-bit Maynard QIC-02 board into an empty slot in your PC, connect the cable to the board and the drive, and plug the power cord into the drive—all standard procedures. When we installed the *MaynStream* software, we found a minor problem in its installation routine. When running the SHARE program, as is standard for a large-disk partition, the installation program bombed when it tried to install the second of four disks. You can still install the program manually, or install it automatically by rebooting without SHARE, but neither approach is an elegant solution. Maynard says it should have the problem corrected by the time this article is published.

This glitch aside, the software works as advertised. The program can find the Maynard card automatically, without being told the card's jumper settings for IRQ, DMA, and address—a nice touch. Its menu structure offers a large number of options without being overwhelming. For example, to back up, you only have to choose Backup, then Go. Alternatively, you choose Backup and then Select to choose specific files. To save a defined selection for future use, pick Name Script, and the name you specify will appear on the menu. Restore works similarly, so that you only have to choose Restore-Go or Restore-Select to initiate a restoration.

MaynStream also provides an image backup option. However, it's hidden in the Utilities menu, since Maynard maintains that file-by-file backup is the preferred, more reliable approach. According to Maynard, *MaynStream* supports Novell *NetWare 286* and *NetWare 386*, 3Com networks, and IBM *PC LAN*.

FACT FILE

MaynStream 150Q
Maynard Inc., 460 E. Semoran Blvd., Casselberry, FL 32707; (800) 821-8782, (407) 263-3500.
Software: Proprietary.
List Price: External drive, ISA or EISA bus (with software), $2,195; internal drive, ISA or EISA board (with software), $1,895; external drive, MCA board (with software), $2,295; internal drive, MCA board (with software), $1,995.
Requires: DOS 2.1 or later, 512K RAM.
In Short: The MaynStream package offers ease of use and fast performance. Maynard's proprietary software offers a large number of options in a deceptively simple menu structure. Pricey, but worth it.

CIRCLE 613 ON READER SERVICE CARD

HARDWARE
TAPE DRIVES

The Maynard MaynStream 150Q took only 19.5 minutes to complete the PC Labs file-by-file backup test, and about 23 minutes to restore the data to disk, making the drive one of the fastest performers on these tests. On the single-directory performance tests, Maynard's entry finished quickly, taking just 5 minutes to back up the data and 6 minutes to restore it.

Maynard's image backup records a true image of the entire disk. The drive took about 51.5 minutes to perform the backup and about 52 minutes to complete the restoration.

With speed that makes it a front-runner and software that has a well-designed menu structure, the Maynard 150Q package has a lot going for it. Even the warranty Maynard offers is noteworthy: one year on the drive and five years on the controller board. At $2,195, this package is undeniably expensive, but it certainly offers great price value.

MICRONET TECHNOLOGY INC.

MT-150/DOS

by M. David Stone

MicroNet Technology's MT-150/DOS is the sort of package that's best described as plain-vanilla. Assembled from a set of standard parts—a Tandberg tape drive, an Adaptec interface board, and Sytron's *SY-TOS* software—the MT-150/DOS does its job with little fuss. Even its price is ordinary: the package we tested, which features a 16-bit ISA SCSI board and an external drive, costs $1,795 and has a one-year warranty. An internal version costs $100 less.

The system we evaluated is only one of MicroNet Technology's offerings. The vendor has boards that will work in an 8-bit ISA slot (external package, $1,795; internal package, $1,695), a 32-bit EISA slot (external, $1,995; internal, $1,885), or a 32-bit MCA slot (external, $1,995; internal, $1,885). The MT-150/DOS can handle both standard-length (150MB) and extended-length (250MB) cartridges. The external drive measures 3 by 10 by 10.5 (HWD) inches, which makes it wider than most drives but not as long.

Sytron's *SY-TOS* software, version 3.02, supplies quick file access for the drive as well as supports Novell *NetWare 286*, *NetWare 386*, and 3Com networks. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *SY-TOS*.) According to MicroNet, the drive will also work with Sytron's *Sytos Plus* and with Emerald's *EmSAVE*, although MicroNet does not sell either program.

FACT FILE

MT-150/DOS
MicroNet Technology Inc., 20 Mason St., Irvine, CA 92718; (714) 837-6033.
Software: *SY-TOS* version 3.02.
List Price: External drive, ISA board (with software), $1,795; external drive EISA board (with software), $1,995; internal drive, ISA or MCA board (with software), $1,695; internal drive, EISA or MCA board (with software), $1,885.
Requires: DOS 3.0 or later, 512K RAM.
In Short: Industry-standard *SY-TOS* software, a Tandberg tape drive, and an Adaptec SCSI controller card work together to let the MT-150/DOS do its job with little fuss.

CIRCLE 614 ON READER SERVICE CARD

MODIFYING CONFIG.SYS

To install the MicroNet drive, you'll have to modify your CONFIG.SYS file, since the Adaptec 1542B SCSI board makes this one of the few systems in this roundup that requires a device driver. The installation guide clearly explains how to modify CONFIG.SYS, but this is still a manual procedure that some other systems take care of automatically. If you install the hardware before changing your CONFIG.SYS file, you will be greeted with an error message from the Adaptec board when you turn on your computer.

To install the hardware, simply plug the board into an empty slot in your PC, set the SCSI ID selector on the tape drive, connect the cable between the board and the drive, and plug in a power cable.

On the PC Labs performance tests, the MicroNet MT-150/DOS performed the *SY-TOS*-modified image backup in about 26 minutes, and restored the data in about 25.5 minutes—all average times. File-by-file backup times were also as expected: about 26 minutes for the full backup and about 7.5 minutes for the directory backup. However, the MT-150/DOS's file-by-file restoration times were surprisingly slow. The device took about 39 minutes to complete the File-by-File Restore test, and about 10 minutes to finish the Directory Restore test.

MicroNet says that slow restoration performance occurs only on Compaq

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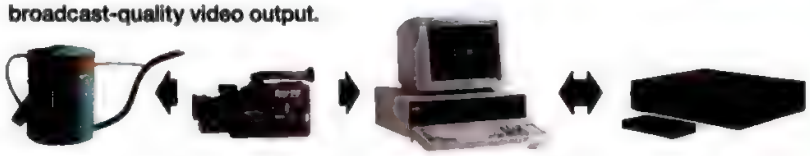

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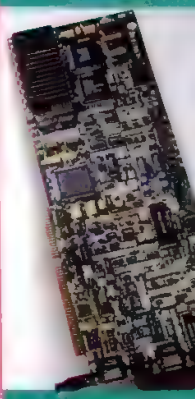

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Deskpro 386/25 machines that use a Compaq ESDI drive—the system we used in our tests. According to the vendor, this problem does not occur with other systems that use an ESDI drive, or with Compaqs that use a SCSI drive.

Clearly, if you have a Compaq Deskpro 386/25 with a Compaq ESDI drive and want a fast tape backup system, you should look elsewhere. If you have another computer, you may still want to consider MicroNet's MT-150/DOS. But play it safe and take it for a test drive first.

MOUNTAIN NETWORK SOLUTIONS INC.

FileSafe 7250

by Bruce Brown

On the expensive side of tape backup systems reviewed in this issue, Mountain Network Solutions' FileSafe 7250 is also one of the more feature-laden. But if we had to choose one feature of the $2,495 package (including external tape drive, QIC 02 ISA interface board, and *FileSafe*, version 5.0 software) that stands out above all others, it would be QFA, Mountain's proprietary implementation of quick file access.

The benefit of QFA, which is the system default, is that it makes the process of retrieving individual files or groups of files faster than with systems that must sequentially search an entire tape or series of tapes.

Mountain's other tape backup packages also fall on the high end of the price spectrum. Its internal drive with an ISA interface board costs $1,895; an external drive with an MCA board costs $2,595. Standard-length (150MB) and extended-length (250MB) tapes will work on all of these systems.

FACT FILE

FileSafe 7250
Mountain Network Solutions Inc., 240 E. Hacienda Ave., Campbell, CA 95008; (800) 458-0300, (408) 379-4300.
Software: Propretary.
List Price: External drive, ISA board, $2,495; internal drive, ISA board, $1,895; external drive, MCA board, $2,595
Requires: DOS 3.0 or later, 384K RAM.
In Short: The FileSafe 7250 combines high-speed backups with user-selectable quick file access, both of which help to justify its high price.

CIRCLE 615 ON READER SERVICE CARD

In addition to supplying the software, Mountain makes the 8-bit interface board and the drive electronics for the FileSafe 7250. The drive's mechanics come from Sankyo Seiki. The 6.5- by 4.5- by 12-inch (HWD) tape drive houses its own power supply. Its case has an LCD panel that keeps you apprised of the unit's activity.

A HANDY REFERENCE

Because Mountain makes all the system components, its documentation covers hardware as well as software installation. With the manual close at hand, you won't find it difficult to slip the board into an available 8-bit slot and, if necessary, change its settings, run a cable between the board and the drive, and attach a power cord to the drive.

Installing and using Mountain's *FileSafe* software is just as easy. You can access all operations from a series of hierarchical menus or, if you prefer, from the DOS command line or through DOS batch files. While *FileSafe* doesn't directly support multiple disk backups in a single pass, you can still accomplish this by writing a batch file.

For automatic backups, *FileSafe* includes *AutoRun*, a TSR that watches your PC's system clock and calendar and then runs specified operations at a previously selected time. *FileSafe* also supports networks, among them those running Novell *NetWare 286* or *NetWare 386*, 3Com networks, and Banyan *VINES*.

The FileSafe 7250 is fast at retrieving individual files and groups of files, due to its use of QFA. But, as its results on the PC Labs performance tests prove, the system is also fast at performing file-by-file and image backups and restorations of entire hard disks. The FileSafe 7250 completed the file-by-file backup and restore tests in 20.5 minutes and 22 minutes, respectively. Its times on the image backup and restore tests were just over 21 minutes and just under 21 minutes, respectively. Backing up our test directory took the unit 6.5 minutes; restoring that data took 6 minutes.

With significantly faster-than-average performance times and support of quick file access, the FileSafe 7250 offers a lot—for a lot of money. But if you expect to often have to bring back single files or selected groups of files from tape, the time savings offered by the FileSafe 7250 are worth the additional cost.

NCR CORP., PERIPHERAL PRODUCTS DIVISION

NCR 6091 150 MB SCSI Tape SubSystem

by Bruce Brown

NCR's 6091 150 MB SCSI Tape SubSystem is a special case—that is, its case is special. Part of a series of modular external storage devices, including larger-format tape drives, hard disk drives, and optical disk drives, the NCR 6091 features an interlocking, stackable case with SCSI input and output ports. Apart from that, the $2,249 NCR 6091 is made up of standard parts, including an Archive tape drive, a 16-bit ISA Western Digital SCSI interface board, and Sytron's *SY-TOS* backup software. The system is also available with a Micro Channel interface board for the same price.

The NCR 6091 unit houses its own power supply, measures 4.75 by 6.5 by 14.5 (HWD) inches (the standard size for 6091 SubSystem units), and handles both standard-length (150MB) and extended-length (250MB) tapes. It does not support quick file access offered by several other drives in this roundup. Since it has been specially designed to work with other NCR units, the 6091 is most likely to be sold as part of an all-NCR system.

Because it's a SCSI device, the NCR 6091 is a bit more complicated to install than other systems. Installation isn't made any easier by NCR's documentation, which contains all the information you need but doesn't present it in an accessible style, especially if you're a novice.

FACT FILE

NCR 6091 150 MB SCSI Tape SubSystem
NCR Corp., Peripheral Products Division, 3718 N. Rock Rd., Wichita, KS 67226; (800) 325-7274, (316) 636-8000.
Software: *SY-TOS* version 3.02 (for ISA); *Sytos Plus* (for MCA).
List Price: External drive, ISA or MCA board (with software), $2,249.
Requires: DOS 3.0 or later, 512K RAM.
In Short: This NCR tape backup unit is an external SCSI interface model that can stack and daisy-chain with other NCR SCSI subsystems, including hard disks and optical disk drives. Modularity aside, it's a standard tape backup system that utilizes an Archive tape drive, a Western Digital SCSI controller, and *SY-TOS* tape backup software.

CIRCLE 616 ON READER SERVICE CARD

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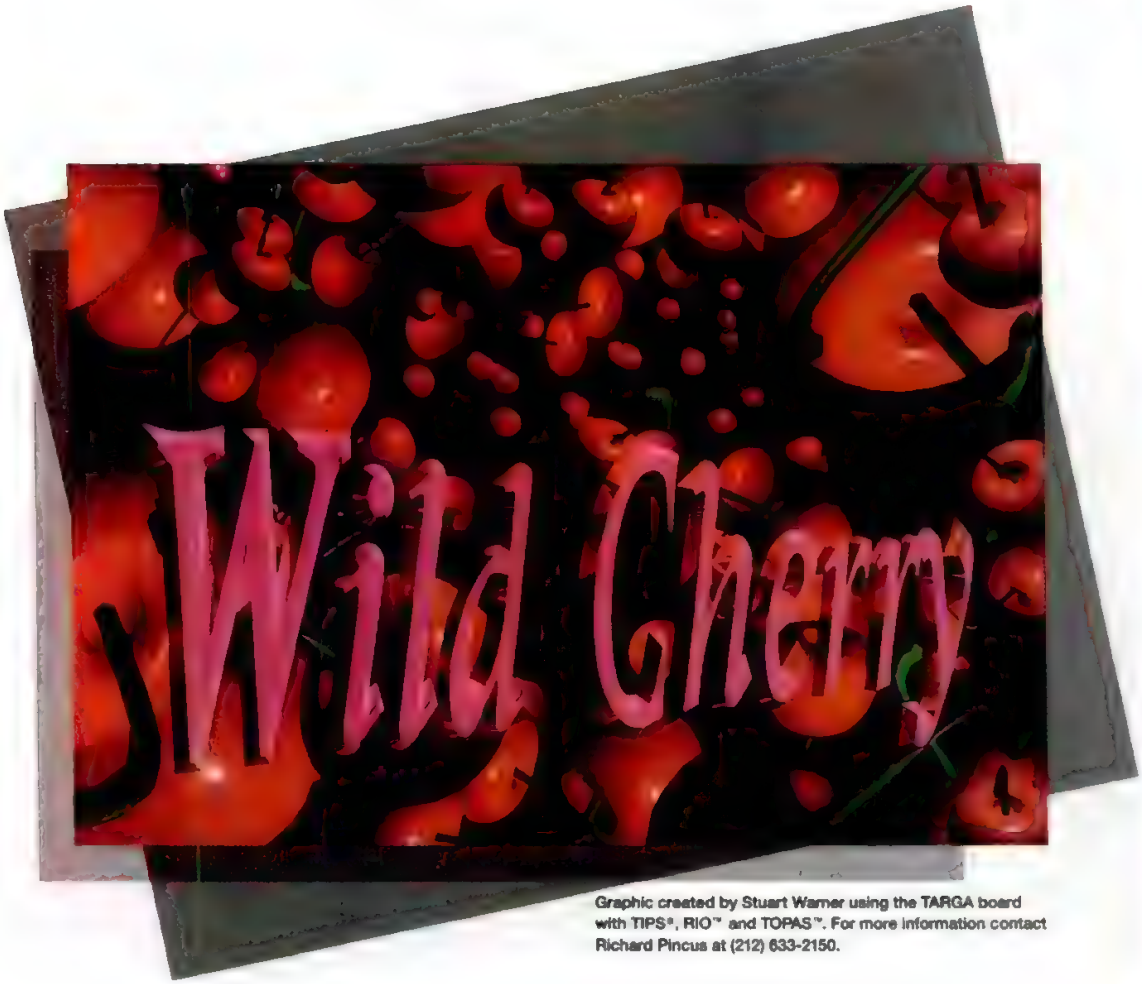

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CIRCLE 521 ON READER SERVICE CARD

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ENTER THE TERMINATOR

To install the NCR 6091 (our only SCSI device) in our test configuration, the front cover was removed, its device number dial set to 7, and the terminator (which is packed with the documentation) was plugged into the top of the two ports on the back of the drive. Once that was accomplished, the drive was ready to be controlled by the interface board, and the board was installed into our Compaq Deskpro 386/25, the supplied cable attached between the board and the drive, and the software was installed using *SY-TOS*'s standard STINSTAL program. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *SY-TOS*.)

Even if the NCR 6091's documentation is frustratingly obscure, its performance is pleasantly quick on the whole. NCR's entry took about 20.5 minutes to complete the PC Labs File-by-File Backup test, and about 29 minutes to restore that data to disk. Image backup and restore took 20.5 minutes and 22.5 minutes, respectively, and directory backup and restore took 6.5 minutes and just under 8 minutes, respectively.

Overall, the NCR 6091 is a solid performer built on standard parts that will appeal primarily to users of other NCR Sub-System components. Its list price is on the high side, but that's the premium you'll have to pay for its modular design.

NOVASTOR CORP.

NovaStor NST150

by Bruce Brown

While the NovaStor NST150 handles standard-length (150MB) and extended-length (250MB) tapes and can be used with either standalone PCs or networks, its *raison d'etre* differs from that of the other systems reviewed here. For the NST150's combination of SCSI technology and proprietary software allows the system to control a variety of tape devices, among them those that use nine-track tapes and 4-millimeter and 8-mm. tapes. People who need a system that's compatible with those formats will more than likely forgive the NovaStor's considerably slower than average backup and restore times, especially given its moderate $1,495 list price.

As tested, the NovaStor NST150 consists of a 3.4- by 10- by 10.5-inch (HWD) external Tandberg drive, an Always Technology 16-bit ISA SCSI interface board, and version 3.50 of NovaStor's *NovaBack* software; MCA or EISA boards are also available at the same system price. An internal drive package, including either an ISA, EISA, or MCA interface board, costs $1,195. Unlike many vendors that charge a premium for Micro Channel-compatible packages, NovaStor sells internal and external systems with MCA interface boards at the same prices as its ISA packages.

Since you'll have to refer to separate manuals for the interface board and the software, you may find that it will take a beat longer to install the NST150 than some other tape drive systems. Even still, installation will take only a few minutes, especially if the NST150 is the only SCSI device attached to your PC. If other SCSI devices are present, installation becomes a bit more complicated, since both the SCSI hardware and the software have to know which device has which SCSI identity.

> Users who need a system that's compatible with different formats will more than likely forgive the NovaStor's slower speed, especially given its low price.

MULTIPLE DRIVE SUPPORT

The NST150's software consists of separate modules that you can run individually or in batch mode from the DOS command line; both background and foreground operations are supported, but data compression and quick file access are not.

We ran all our tests using the menu-driven *NovaBack* program, which can perform file-by-file backups but not image backups. *NovaBack* does offer a feature not found in many other backup programs: it lets you specify multiple disks or partitions for a single backup, which is useful for PCs that have more than one hard drive or for networks. *NovaBack* supports networks running Novell *NetWare 286* or *NetWare 386* and those from Banyan.

If one thing does hamper the NovaStor NST150, it's the unit's data transfer rate. One of the slowest systems we saw, the NST150 took 47.5 minutes to complete our File-by-File Backup test and about 51 minutes to restore that data to disk. On our directory backup and restore tests, its scores were 12.5 minutes and under 13 minutes, respectively.

If backing up data to 150MB tapes were the NovaStor's only function, the device would come up short on performance for the dollar. But since that activity is almost a side issue for the NST150, we think the NovaStor deserves a close look by people who need compatibility with multiple tape formats.

FACT FILE

NovaStor NST150
NovaStor Corp., 31828 Village Center Rd., Westlake Village, CA 91361; (818) 707-9900.
Software: Propnetary.
List Price: External drive, ISA, MCA, or EISA board (with software) $1,495; internal drive, ISA, MCA, or EISA board (with software), $1,195.
Requires: DOS 2.0 or later, 256K RAM.
In Short: The NovaStor NST150 is slow at normal 150MB tape backup operations. But its real reason for being is to cooperate with nine-track and 4-mm. and 8-mm. tape units. If you need to access to those formats, this system is worth a look.

CIRCLE 617 ON READER SERVICE CARD

OSICOM TECHNOLOGIES INC.

Osicom Osibak 150S

by Bruce Brown

Osicom Technologies' Osibak 150S has the distinction of being the lowest-priced tape backup system we tested. This $820 package features an internal half-height Cipher tape drive, a Future Domain SCSI interface board, version 3.0 of Sytron's *SY-TOS* backup software, and backup times that beat many of its higher-priced competitors.

Low price has a cost in this case, since Osicom's entry is the only QIC 150 tape drive we evaluated that doesn't accept extended-length (250MB) tapes. If you can make do with a storage capacity of 150MB per tape, keep reading.

Like most of the drives in this roundup,

The question is not "do you need a network?"; the question is "what kind of network do you need?"

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- ☐ *5. Access a common library of data files, like drawings, document templates, memos, boilerplate, etc.*
- ☐ *6. Access a common database, where multiple users must access the same records simultaneously (e.g. an order entry system)*

If you checked any or all of the first five capabilities listed above, but not number six, your company does ***not*** need a full-blown LAN. This news can save your company a lot of money and make life much simpler for everyone concerned. Skip to the next paragraph immediately. If you selected the sixth capability, a data-sharing LAN is needed, but only for those users who must access the shared database. To achieve the other capabilities, your best—and most economic—solution is...

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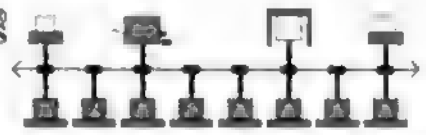

Systemizing is an alternative (or supplement) to a LAN. It's a connectivity method that works with practically every computer in existence—ranging from PCs to mainframes—regardless of brand, model, operating system (DOS, UNIX, PICK, etc.), or application. You can Systemize without putting any hardware or software inside your computers. To quote one customer: "It's the most sensible solution to connectivity I've ever encountered!"

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CIRCLE 185 ON READER SERVICE CARD

the Osibak 150S is a plug-and-play device. Simply position the ISA interface card into an available 8-bit slot, secure the drive in a half-height drive bay, attach a cable between the drive and the card, install *SY-TOS*, and you're ready to backup. Installation should only be more complicated if your system has other SCSI devices, but even in that case Osicom's documentation should answer most of your questions.

THE SY-TOS STANDARD

Because it uses *SY-TOS*, the Osibak 150S provides you with the same software feature set—including menu, command line, and batch file operation modes, and flexible file, disk, and device backup and restore options—as many other systems.

FACT FILE

Osicom Osibak 150S
Osicom Technologies Inc., 198 Green Pond Rd., Rockaway, NJ 07866; (800) 922-0881, (201) 586-2550.
Software: *SY-TOS* version 3.0.
List Price: Internal drive, ISA board (with software), $820.
Requires: DOS 3.0 or later, 512K RAM.
In Short: The Osibak 150S offers a hard-to-beat combination of low price and high performance, but its internal tape drive can only accommodate 150MB tapes.

CIRCLE 618 ON READER SERVICE CARD

Similarly, *SY-TOS* allows the Osibak to work with several networks, among them those running Novell *NetWare 286* or *NetWare 386*, 3Com, and Banyan. The system does not offer quick file access.

As for performance, the Osibak 150S pulls out some of the stops. Its times on the PC Labs File-by-File Backup test (21 minutes) and the image backup and restore tests (20.5 minutes each) were among the fastest we saw; while restoring file-by-file, the drive turned in a considerably slower-than-average time of 36.5 minutes. Its times on the directory backup and restore tests were 6 minutes and 9.5 minutes, respectively—both on the slow side of average, but still acceptable.

If you need an external system or must use extended-length tapes, you'll have to pass up the low-cost Osibak 150S. But if your system has a spare half-height drive bay and can use an 8-bit ISA SCSI card, and you can live with using standard-length tapes, it's hard to think of a reason not to use the Osibak 150S.

Rob Peter to Pay Paul

NORTON USERS: Upgrade to MACE UTILITIES Version 1990 for just $50!

PC MAGAZINE EDITORS' CHOICE
March 27, 1990
The Mace Utilities, Version 1990

"Mace Utilities, Version 1990: Emergency Room Pushes Aside Norton's Disk Doctor"

". . .it can get you out of hot water while other programs are vainly attempting to save the day"

- Edward Mendelsohn,
PC MAGAZINE *Associate Editor*

Now that the jury is in, a lot of people who bought Peter Norton's **Norton Utilities Advanced Edition** *wish* they had bought Paul Mace's **Mace Utilities Version 1990** *instead.*

It's easy to understand. In announcing its prestigious Editor's Choice Award, **PC Magazine** noted that **The Mace Utilities Version 1990** *"repairs damage that nothing else has the nerve to even look at."*

Well, here's good news. If you bought Norton Utilities, just "*rob*" the title page from the User Manual, and we'll upgrade you to **Mace Utilities Version 1990** for just $50. That's $100 off the retail price, right now!

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Owners of any *other* disk utilities program can take advantage of the same offer. Credit card owners can upgrade by calling 1-800-873-4384.

Offer will expire on October 31, 1990.

CIRCLE 236 ON READER SERVICE CARD

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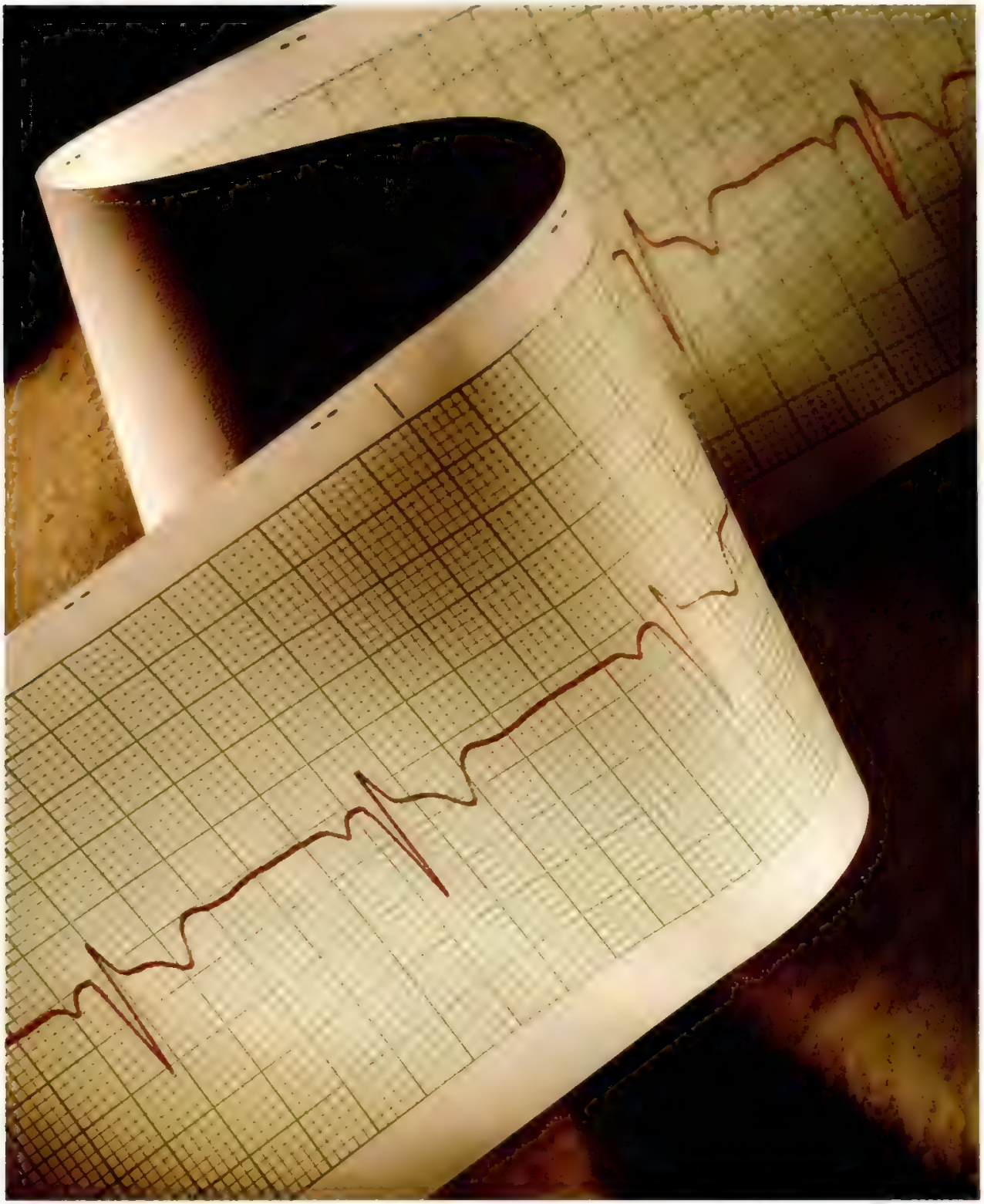

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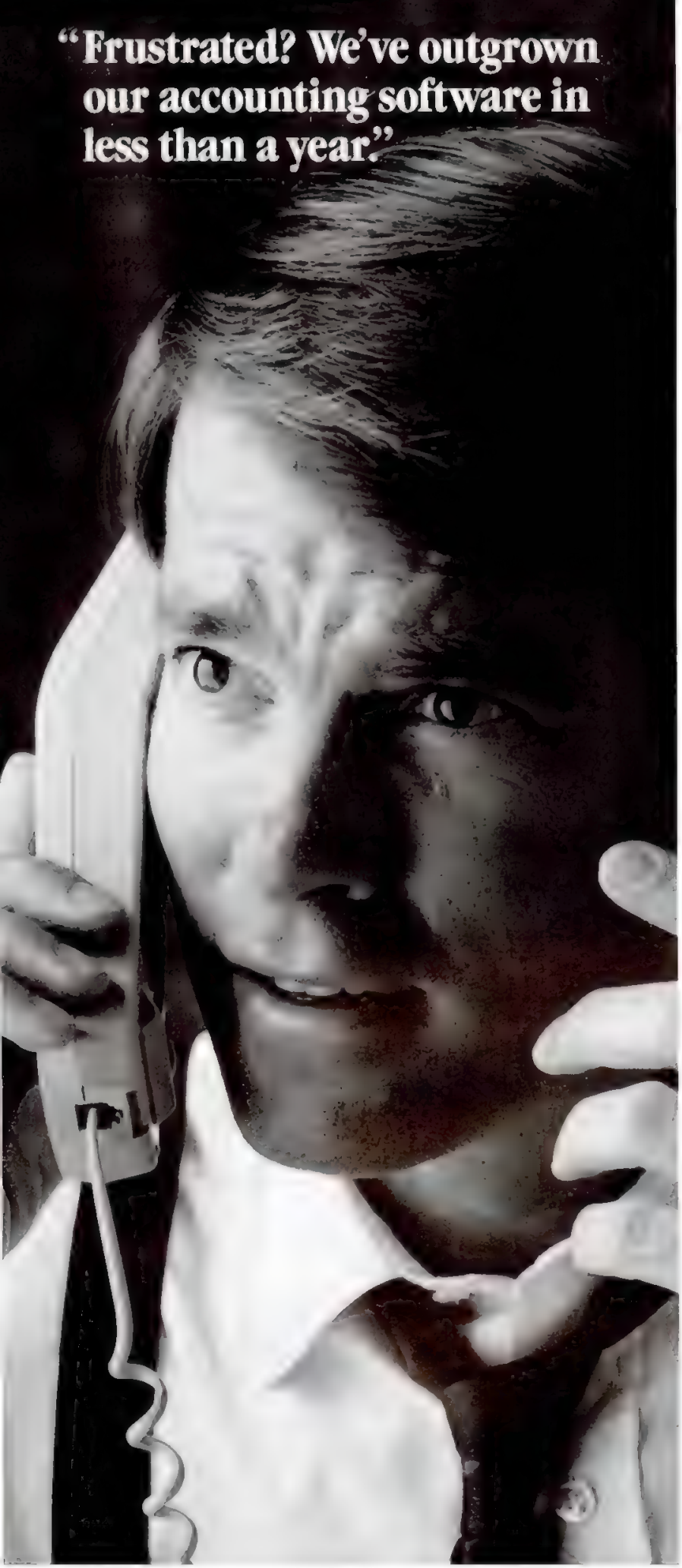
CIRCLE 322 ON READER SERVICE CARD



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CIRCLE 263 ON READER SERVICE CARD

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SANKYO SEIKI (AMERICA) INC.

Sankyo ET 150 E

by Bruce Brown

Like Wangtek and Tandberg, whose systems are also reviewed in this issue, Sankyo Seiki is a major supplier of tape drives to other vendors. As reviewed, its own $1,395 tape-backup package features—what else—a Sankyo external tape drive, an Everex ISA QIC 36 interface board, and Version 3.0 of Sytron's *SY-TOS*, a combination best described as generic but very capable.

If Sankyo's 2.75- by 7.5- by 12.25-inch (HWD) external unit isn't what you're looking for, the vendor also offers an internal drive with an ISA interface board for $1,095. If you own a PS/2, you still have a choice: Sankyo sells an external drive with an MCA interface board for $1,495. And, if you don't want to use *SY-TOS*, you can opt for Sankyo's own *ET* backup software, and reduce the price of the ISA systems by $100. All the systems handle both standard-length (150MB) and extended-length (250MB) tapes.

Installing the Sankyo ET 150 E couldn't be easier, which is fortunate since its hardware documentation is pretty sparse. Just set the preconfigured 8-bit interface board into an available slot, run a cable between the interface board and the drive, and install *SY-TOS* using its own automatic installation program.

In addition to trouble-free installation, *SY-TOS* brings network support to the Sankyo ET 150 E, including the ability to perform automatic unattended backups. Among the supported networks are those running Novell *NetWare 286* and 3Com. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *SY-TOS*.) The system does not offer quick file access.

> In addition to trouble-free installation and network support, the Sankyo ET 150 E can perform automatic unattended backups.

NO SURPRISES

On the PC Labs tests, the Sankyo ET 150 E turned in performance times similar to other ISA bus systems using *SY-TOS*. It completed our file-by-file backup and restore tests in about 26 minutes and about 28 minutes, respectively, and our image backup and restore tests in about 26 minutes and about 25 minutes, respectively. The system took about 7.5 minutes to finish our Directory Backup test, and just under 8 minutes to restore that data to disk. We encountered no surprises during testing—just what you'd hope for in a system that's supposed to serve as a safety net.

With average performance times, standard components, and a moderate price, the Sankyo ET 150 E is a workhorse solution that will get the job done.

FACT FILE

Sankyo ET 150 E
Sankyo Seiki (America) Inc., Tape Product Division, 955 Francisco St., Torrance, CA 90502; (800) 688-0098, (213) 538-1030.
Software: *SY-TOS* version 3.0 or proprietary.
List Price: External drive, ISA board (with *SY-TOS*), $1,395 ($1,295 with proprietary software), internal drive, ISA board (with *SY-TOS*) $1,095 ($995 with proprietary software); external drive, MCA board (with proprietary software), $1,495.
Requires: DOS 2.1 or later, 512K RAM.
In Short: Yet another system that uses an Everex QIC 02 interface board and *SY-TOS* tape backup software. But this time it comes from one of the major tape drive manufacturers. The Sankyo ET 150 E performs as expected and is available at a reasonable price.

CIRCLE 619 ON READER SERVICE CARD

SYSGEN INC.

Sysgen Maxi TS250e

by Bill O'Brien

Unlike most of the external tape drives we evaluated, Sysgen's $1,595 Maxi TS250e stands out because of its appearance. The unit's 2- by 12- by 14.25-inch (HWD) casing is wide enough to house two tape drives side by side. In fact, the company offers the chassis with two tape drives installed for $2,895.

Our evaluation unit came with one Archive drive and a 16-bit Sysgen SCSI interface board, which the company sells for $195. (An MCA board costs $250, and an internal tape drive costs $1,395.) Standard-length (150MB) cartridges are its normal fare, but it can accept extended-length (250MB) cartridges as well. The unit does not support quick file access.

Sysgen's documentation has a decidedly corporate look: IBM handbook-sized, three-hole-punched device and software supplements come with the drive. The documentation may look imposing, but it doesn't tell you which of the two rear-mounted SCSI connectors should be used for input and which should be used as the pass-through connector for the next drive in line. We followed the manual's illustrations and were able to make the proper connections.

A WORD OF CAUTION

Because it's a SCSI device, the Maxi TS250e requires a device driver, which is provided by Sysgen and is installed automatically with the rest of the software; hardware installation is straightforward. However, Sysgen also sells SCSI hard disks and adapters that use the same driver, and the remainder of the software on the single disk included with the tape drive is used to initialize and format its hard disks. Do not attempt to use any of it.

Sysgen's backup software of choice for the Maxi TS250e is a $100 OEM version of Sytron's *SY-TOS*, tailored to handle SCSI. The software offers file, partition, and full-image backup procedures, as well as batch mode and unattended procedures. You'll be able to recognize standard backup and restore processes on *SY-TOS*' hierarchical menus, but certain subtleties, such as restore redirection to a different path than that of origin, require several steps that are not at all obvious. (See the sidebar "Standard Software: *SY-TOS* and *Sytos*

FACT FILE

Sysgen Maxi TS250e
Sysgen Inc., 556 Gibraltar Dr., Milpitas, CA 95035; (408) 263-4411.
Software: *SY-TOS* version 3.02 or proprietary.
List Price: External chassis with one drive installed, $1,595; with two drives installed, $2,895; internal tape drive, $1,395.
Requires: DOS 3.0 or later, 512K.
In Short: The Sysgen Maxi TS250e's enclosure may seem odd at first glance, but it can house two tape drives. Its use of heavy-duty *SY-TOS* backup software allows it to grind out the toughest backup assignments.

CIRCLE 620 ON READER SERVICE CARD

Plus" for more information on *SY-TOS*.)

For networks running Novell *NetWare 286*, Sysgen offers its own $295 *MaxiBack* software, which offers queued backup procedures and will accept commands from either the server or from a workstation.

Overall, the Maxi TS250e was a faster-than-average performer on the PC Labs performance tests. It completed our file-by-file backup test in under 21 minutes, and restored that data to disk in just over 26 minutes. On our image backup and restore tests, its times were 21 seconds for each. And on our directory tests, it backed up the data in under 6 minutes and restored it in 8.5 minutes.

Using software that's fit for hard duty, and providing faster-than-average backup times, the wide-body Sysgen Maxi TS250e could well be a good choice for power users. Its ability to hold a second tape drive along with the SCSI interface's support for several drives in line make the unit a viable choice for network users as well.

TALLGRASS TECHNOLOGIES CORP.

FSO 150e

by M. David Stone

Tallgrass Technologies' FSO 150e is a distinctive tape backup system in a product category rife with commodity items. Built around a Cipher drive, the FSO 150e comes with a Tallgrass SCSI board and Tallgrass' *FileSecure* software, which alone gives the $1,795 system a unique personality. Add to that a two-year warranty—double the usual length—and software-based data compression, and the package distinguishes itself even more.

In a smart move to save desk space, Tallgrass chose to mount its external drive vertically, so that it measures 7 by 4 by 14.75 (HWD) inches—about twice as high as most external drives, but two inches narrower. A $1,595 internal drive package (with either an ISA, EISA, or MCA interface board) is also available. We evaluated an external ISA version of the Tallgrass system (EISA and MCA boards are available for this unit at the same system price) and used version 1.34 of *FileSecure*.

Unlike most of the tape backup systems we looked at, the Tallgrass FSO 150e offers a data compression option. With data compression turned off, you can store the usual 150MB of data on a standard-length tape or 250MB of data on an extended-length tape. With data compression enabled, the system will on average double the capacity, yielding a maximum of 500MB of storage on a single cartridge. On PC Labs' tests, we saw a 1.9:1 compression ratio for the file-by-file backup of the hard disk, and a 2.2:1 compression ratio for the directory backup.

The FSO 150e's data compression is software-based, which means that the price for additional storage capacity is slower backup times. According to Tallgrass, this speed penalty is only significant on slow PCs. On the PC Labs tests using a Compaq Deskpro 386/25, the speeds for backups with compression enabled were about 1.3 to 1.5 times slower than those for backups without compression. There was no big difference in restoration times.

FileSecure comes with data compression turned off. When it restores data, the system automatically detects whether the data is compressed, and uncompresses accordingly.

FACT FILE
EDITOR'S CHOICE

FSO 150e
Tallgrass Technologies Corp., 11100 W. 82nd St., Lenexa, KS 66214; (800) 736-6002, (913) 492-6002.
Software: Propretary.
List Price: External drive, ISA, EISA, or MCA board (with software), $1,795; internal drive, ISA, EISA, or MCA board (with software), $1,595.
Requires: DOS 2.1 or later, 384K RAM.
In Short: A two-year warranty—twice the usual length—is behind the Tallgrass FSO 150e hardware. Tallgrass' own *FileSecure* software provides a straightforward menu structure, optional data compression, and performance on the fast side of average—all of which makes this one of the better choices among tape drives.

CIRCLE 621 ON READER SERVICE CARD

SCSI YET SIMPLE

Unlike some other systems that use SCSI boards, the FSO 150e hardware is extremely straightforward to install. Simply set the 8-bit card into an available slot, connect the cable between the card and the drive, and plug the power cord into the drive. Like most boards, the Tallgrass card has jumpers for changing IRQ, DMA, and address, but in most cases you can use the factory settings.

Software installation is typical, with an installation module that asks what kind of monitor you have and what drive and directory to use, and then copies the software to your hard disk. *FileSecure* provides quick file access and supports Novell *NetWare 286* and *NetWare 386*. Its well planned menu structure puts all its features just where you expect to find them.

For example, to backup data, you choose Backup from the main menu, and then either Total backup, Modified backup (of new or modified files only), or Selective backup (to select specific files). To restore data, you select Restore from the main menu, and then either Total restore or Selective restore. Other options let you schedule unattended backups, configure the program, and erase tapes.

The FSO 150e was a better-than-average performer on the PC Labs performance tests. It completed a file-by-file backup of the hard disk in about 23 minutes, and restored the data to the disk in about 21 minutes. It took about 8.5 minutes to backup a single directory of about 30MB of data, and about 6.5 minutes to restore those files to the disk. *FileSecure* does not support image backup.

In many ways besides performance, the Tallgrass FSO 150e is a cut above average. At $1,795, the FSO 150e isn't a steal, but it's still a good buy. Its well-designed software, solid performance, data compression capabilities, and two-year warranty make it well worth the price.

> Unlike most systems we looked at, the Tallgrass FSO 150E offers a data compression option.

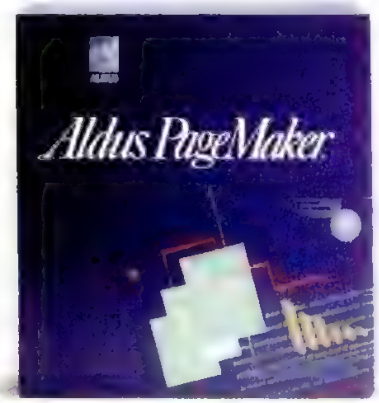
TANDBERG DATA INC.

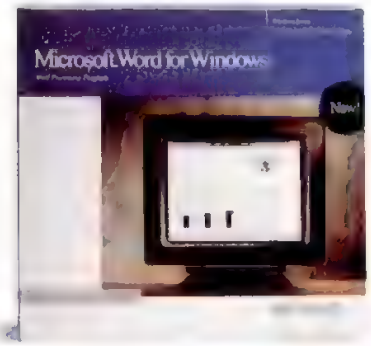
Panther 150

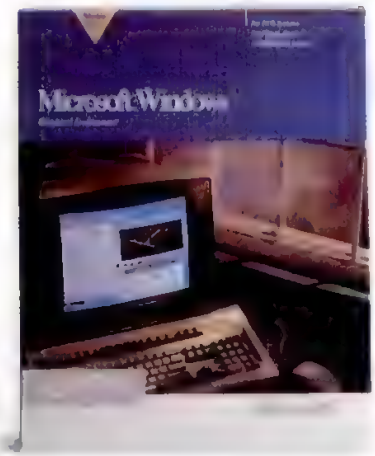
by Ed Perratore

Tandberg Data's external Panther 150 tape drive offers reliable service and plentiful features for its moderate $1,460 list price. The 3.75- by 6.5- by 13.75-inch (HWD) model comes with an Everex QIC 02 ISA interface board and Sytron's *SY-TOS* software. Also available are an internal, half-height version of the drive (with either an ISA or EISA board), which sells for

How to upgrade your favorite Windows programs for $99.*







With ATM software, you get more than you pay for. Including software for these 13 popular fonts, which cost hundreds of dollars if purchased separately. But there are more ways to save—check out the Adobe® Plus Pack for $198. Along with ATM, it completes the full set of 35 fonts found in most PostScript printers. Or try Adobe Type Set™ 1, 2 or 3—each with 7 to 11 fonts for just $99-$198.**

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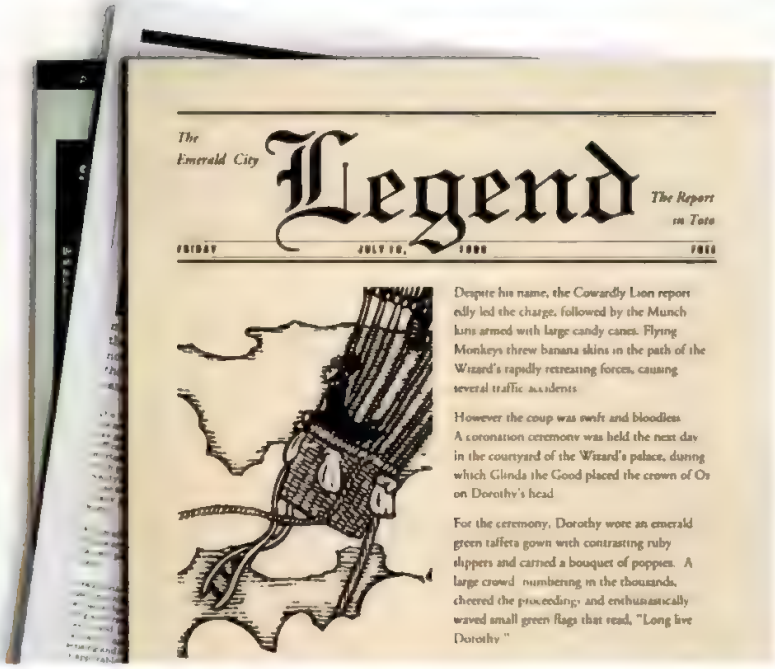

One of the beauties of ATM software is that it automatically scales type to most any size, from headlines to text.

ATM software cleans up the jaggies and brings you closer to true WYSIWYG, because you're using the same outline fonts on screen as in your printer. All of which makes it easy to see how ATM makes Windows 3.0 look good.

Talk about choice—ATM works with the thousands of PostScript® language Type 1 fonts currently available, including the more than 650 typefaces in the Adobe Type Library. So not only can you choose any look you like, but you'll look great once you've done it.

Now your HP LaserJet™ can use the same high-quality fonts only PostScript printers could use before. Plus, your dot matrix or other non-PostScript printer will give you near-laser quality output using the same PostScript language fonts. And since ATM software works with your existing printer drivers, there's no need to modify files.

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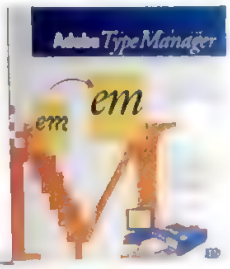

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FACT FILE

Panther 150
Tandberg Data Inc. (formerly Siemens Information Systems), 1077 Business Center Circle, Newbury Park, CA 91320; (800) 537-3866, (805) 375-2500.
Software: *SY-TOS* version 3.0.
List Price: External drive, ISA or EISA board, $1,460 (with software); internal drive, ISA or EISA board, $1,195; external drive, MCA board, $1,560; internal drive, MCA board, $1,295.
Requires: DOS 2.1 or later, 512K RAM.
In Short: Trouble-free backups and restores and ample features make Tandberg's offering worth considering, in spite of slightly lower-than-average speeds.

CIRCLE 622 ON READER SERVICE CARD

$1,195, and internal and external versions with MCA interface boards, which cost $1,295 and $1,560, respectively.

The solidly constructed Tandberg drive accommodates standard-length (150MB) tapes. While the software offers no data compression, you can use an extended-length tape for backups of up to 250MB. And although the drive does not currently support quick file access, Tandberg will offer this feature before the year is out.

Sytron's well documented *SY-TOS* offers a host of options for backing up stand-alone PCs and workstations on Novell *NetWare 286*, *NetWare 386*, 3Com, and IBM networks. The product's foreground operation is fully menu-driven, but you can bypass all this and run the software in batch mode or from the DOS command line. An included utility, SYCLOCK, permits automatic operation at prescheduled times. Backup options include file-by-file, image, and DOS partition; the latter preserves the file structure to permit single-file or directory restores. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *SY-TOS*.)

There's no mystery to installing the hardware. You just insert the QIC 02 interface board into an empty 8-bit slot in your PC, connect the cable between the board and the drive, and plug the power cord into the drive. Jumpers and DIP switches on the board let you set the IRQ, DMA, and address.

DEPENDABLE BUT SLOW

Reliable as the drive proved during testing, its performance times were slightly slower than average. The Panther 150 took nearly 26 minutes to do a file-by-file backup of 120MB of data, and slightly over 28 minutes to restore the data to disk. On our 29MB directory backup and restore, scores also dipped below the norm: almost 8 minutes to backup, over 8 to restore.

One strange occurrence during testing stumped our contacts at both Siemens and Sytron. On the DOS partition backup, *SY-TOS* listed the total Kbytes as 122,056. It later recorded the restore (with no options changed) as totaling 122,072K, a *16K* difference that was not reflected in comparative CHKDSKs of the two identically configured backup machines.

This trifle aside, the Tandberg drive weathered PC Labs' testing without any real problems. The Panther 150 doesn't rank among the fastest drives of the bunch, but it nonetheless merits consideration for solid performance where it really counts.

> The Tecmar package includes an ISA interface board and backup software; it also has one of the simplest installation and setup procedures you'll find.

TECMAR INC.

Tecmar QT-150e

by Bill O'Brien

Tecmar has had its hand in so many aspects of the computer industry that it comes as no surprise to find a Tecmar entry in this roundup. Its QT-150e package, which is comprised of a $2,095 external Wangtek tape drive, a $225 Tecmar QIC 02 ISA interface board (MCA and Mac II adapters are available for $325 and $395, respectively), and the vendor's own *QTOS* backup software, has one of the simplest installation and setup procedures you'll find.

This 7- by 4- by 14.75-inch (HWD) tape drive isn't lacking in bells and whistles. Included on its front panel are an LED track number display and back-lighted panel markings, which indicate drive activity and the direction in which the tape is moving. The Wangtek-manufactured drive can handle both standard-length (150MB) and extended-length (250MB) tapes. If those don't offer enough capacity, you can double those amounts by using the compression backup utility included with versions 1.3 and higher of *QTOS*.

Installing the drive is a snap. Once you've seated the 8-bit interface board in an available slot, simply run a cable between the board and the drive, and plug the power cord into the drive. Jumpers on the board let you set the IRQ, DMA, and address.

EASY-TO-USE SOFTWARE

Tecmar's *QTOS* backup software (Version 1.14 shipped with our evaluation unit) deserves praise for its simplicity. Installation is automatic. If you've done tape backup work before, you'll find *QTOS*' backup procedures to be as intuitive as any could be. If this is new ground for you, Tecmar's 150-page manual will help you handle the rough spots.

QTOS performs true image and file-by-file backups. The latter's backup and restore facilities are flexible enough to handle jobs of any size, down to single-file procedures. You can restore data to the path of origin as well as to any other path or disk. And if you're planning to do tape backup for a network, *QTOS* offers support for those running Novell *NetWare 286* and *NetWare 386*, IBM *PC LAN*, and for those from 3Com and Apple.

We encountered only one problem during testing, and that was when we tried to do a full-disk restore. *QTOS* maintains a swapfile, which is used to hold temporary data needed by the software. Available options let you specify a physical drive name to hold the temporary data or use the generic term "none" to indicate that *QTOS* should use available RAM for its swapfile.

Unfortunately, *QTOS* refused to perform a restore when run from the target disk, displaying an error message indicating that the swapfile could not be assigned to the target disk during a full file-by-file restore. That's logical enough; however, it also displayed the same error message when the swapfile was reassigned to either a floppy disk drive or RAM, even though the target disk was still the hard drive. To overcome the problem, we had to run *QTOS* from the floppy disk drive.

As for performance, the Tecmar QT-150e turned in average results. On the PC Labs file-by-file backup and restore tests,

H,BLAH,BLAH,BLAH,BLAH,BLAH,BLA
BLAH,BLAH,BLAH,BLAH,BLAH,BLAH
LAH,BLAH,BLAH,BLAH,BLAH,BLAH,BI
AH,BLAH,BLAH,BLAH,BLAH,BLAH,BL
H,BLAH,BLAH,BLAH,BLA BLA
BLAH,BLAH,BLAH, AH,
1,BLAH,386EISA,486EISA,BLA

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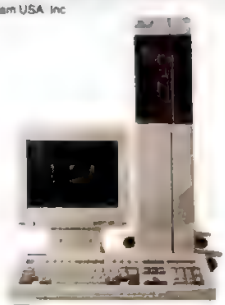

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CIRCLE 372 ON READER SERVICE CARD

its times were 26.5 and 30 minutes, respectively. It completed each of our image backup and restore tests in just over 26 minutes. And on our directory backup and restore tests, its scores were just under 8 minutes and 6.5 minutes, respectively. Quick file access is not an option.

Counted against *QTOS*' batch-file capability, unattended operations mode, command-line access, and network support, the swapfile issue is only a minor annoyance. Combining full functionality with simplicity, the Tecmar QT-150e is a choice worth considering.

FACT FILE

Tecmar QT-150e
Tecmar Inc., 6225 Cochran Rd., Solon, OH 44139; (216) 349-0600.
Software: Proprietary.
List Price: External drive, ISA or EISA board, $2,095 (with software); internal drive (QT-150i), ISA or EISA board, $1,795 (with software); PC Host Adapter, $225; MCA Host Adapter, $325.
Requires: Dos 3.0 or higher, 280K.
In Short: Fast installation and nearly intuitive backup and restore functions make the QT-150e highly desirable.

CIRCLE 623 ON READER SERVICE CARD

HARDWARE
TAPE DRIVES

TENSE LECTRONIX CORP.

TLC Legacy 150x²

by Ed Perratore

A tape backup drive is only as good as its software, and a caveat by a Sytron representative that *Sytos Plus*, Version 1.0, had its problems averted difficulty with an otherwise good product, the TLC Legacy 150x² from Tense Lectronix Corp.

The $1,399 Legacy external drive we tested comes with backup software and a QIC 02 ISA interface board, or you can purchase it with an MCA board for $1,499.

The external drive we tested measures a compact 2.25 by 6 by 13.5 inches (HWD), and supports extended-length (250MB) and standard-length (150MB) tapes with no data compression. Like many of the tape drives we reviewed, Tense Lectronix's entry offers quick file access.

Hardware installation isn't difficult: simply insert the 8-bit interface board into an empty slot in your PC, connect the cable between the board and the drive, and plug the power cord into the drive. DIP switches and jumpers on the board allow you to change the IRQ, DMA, and address, if necessary.

FACT FILE

TLC Legacy 150x²
Tense Lectronix Corp., 200 Butterfield Dr., Ashland, MA 01721; (508) 881-6442.
Software: *Sytos Plus* version 1.1.
List Price: External drive, ISA or EISA board, $1,399 (with software); external drive, MCA board, $1,499 (with software).
Requires: DOS 3.0 or later, 640K RAM.
In Short: Compatibility with the Wangtek standard and versatile industry-standard software are on the side of the TLC Legacy 150x².

CIRCLE 624 ON READER SERVICE CARD

SYTOS PLUS STUMBLES

Once we received an updated version of *Sytos Plus* with drivers for the 150x², we met with only one problem. Our copy of *Sytos Plus*, Version 1.1, gave an error message after we inserted the second 5.25-inch disk when prompted. Only installing from the provided 3.5-inch floppy disk or,

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CIRCLE 495 ON READER SERVICE CARD

Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

as we did, using the DOS XCOPY command to copy the files from the 3.5-inch disk and subdirectories to a 1.2MB disk solved the problem.

Once installed, *Sytos Plus* showed its mettle as the capable tape backup software it is. The program offers no image backup or restore options, but you won't miss them. You can run the software in either attended or unattended mode for file operations on networked as well as standalone PCs. Compatible networks include those of Novell (*NetWare 386* version 3.1, among them), 3Com, Banyan, and IBM. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *Sytos Plus*.) According to Tense Lectronix, the TLC Legacy 150x^2 is compatible with software from any drive modeled after Wangtek's own 150MB QIC 02.

No matter how much TLC you give it, however, the Legacy 150x^2 won't race through your backups. Our evaluation unit took more than 28 minutes to back up 120MB of data, and almost 28 minutes to restore it to disk, placing it on the slow side of average. Both backup and restore in our single directory tests took a hair under 8 minutes.

Lightweight yet sturdy, slow yet reliable, the TLC Legacy 150x^2 makes a decent showing in a competitive product arena. You won't be sorry if you pick this one, especially at its attractive price. But if you're looking for blazing speed, this isn't the place to find it.

WANGTEK INC.

Wangtek LS 5150 PK

by M. David Stone

Since Wangtek makes its tape drives available as OEM products, it's tempting to think of the LS 5150 PK as a generic package even though the drive and controller come from Wangtek itself. That impression is reinforced by Wangtek's use of industry-standard software—version 1.10 of Sytron's *Sytos Plus*—and by the unit's list price, of $1,510 (external ISA version).

In addition to the unit we looked at, Wangtek offers an internal ISA version ($1,195) as well as external and internal MCA versions ($1,650 and $1,350, respectively). Wangtek also sells the drive with Sytron's *SY-TOS*, and the company says that the drive will work with Tecmar's

FACT FILE

Wangtek LS 5150 PK
Wangtek Inc., 41 Moreland Rd., Simi Valley, CA 93065; (800) 992-9916, (805) 583-5255.
Software: *SY-TOS* version 3.11 (for DOS) or *Sytos Plus* version 1.10.
List Price: External drive, ISA board (with software), $1,510; internal drive, ISA board (with software) $1,195; external drive, MCA board (with software), $1,650; internal drive, MCA board (with software), $1,350.
Requires: DOS 3.0 or later, 458K RAM (640K recommended).
In Short: The Wangtek offering includes Wangtek's own drive and controller and Sytron's *Sytos Plus*—all at a midrange price. There are no extras here, but the unit does just what it promises.

CIRCLE 625 ON READER SERVICE CARD

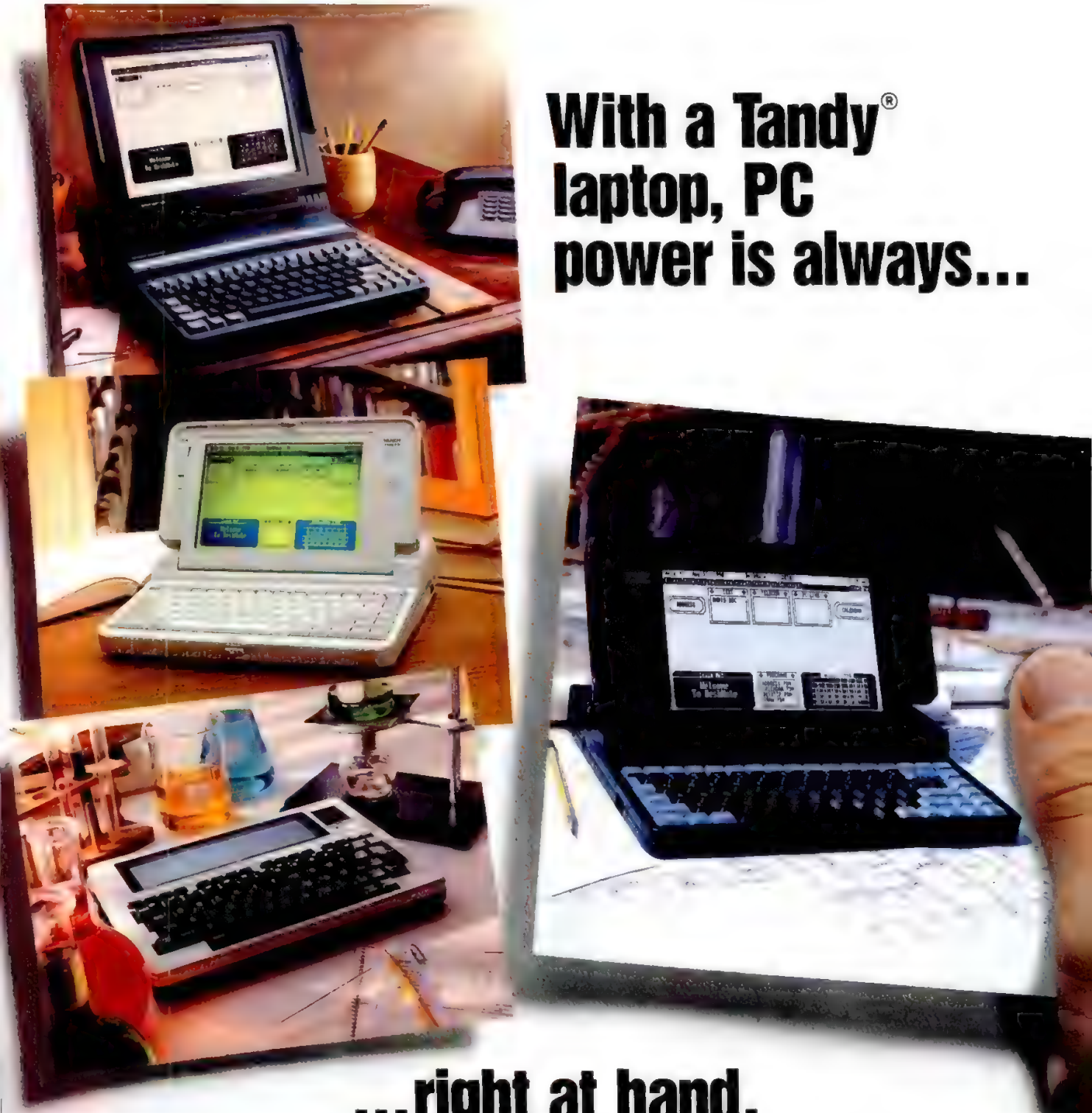
Like most of the drives reviewed in this roundup, Wangtek's LS 5150 PK can store data on both standard-length (150MB) and extended-length (250MB) cartridges. *Sytos Plus* makes use of the drive's quick file access feature and lets the system support Novell *NetWare 286*, *NetWare 386*, 3Com networks, and IBM *PC LAN*. (See the sidebar "Standard Software: *SY-TOS* and *Sytos Plus*" for more information on *Sytos Plus*.)

SETTING IT UP

Hardware installation for the 3- by 6- by 14-inch (HWD) Wangtek unit is typical. You just insert the 8-bit Wangtek QIC-02 board into an empty slot, connect the cable between the card and the drive, and plug the power cable into the drive. Like most interface cards, the Wangtek board has jumpers for setting the IRQ, DMA, and address for the drive. The factory settings are compatible with most systems. *Sytos Plus* comes equipped with its own installation module, which copies the files to your hard disk.

The Wangtek LS 5150 PK took about 28 minutes to complete the PC Labs File-by-File Backup test, and about the same to restore the data to the hard disk. It took 9 minutes to perform the directory backup, and about 8 minutes to finish the directory restore. All of these times are on the slow side of average, but still within the expected range.

Overall, the LS 5150 PK did what it was supposed to on our tests, with no surprises—just what you should expect of a tape backup system. ■



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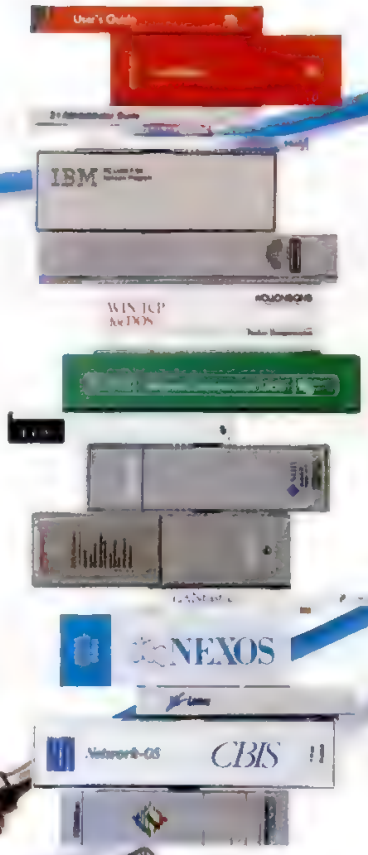

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FTP Software PC/TCP	▲	▲	
Wollongong WIN/TCP	●	▲	
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Sun PC-NFS		▲	
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SCSI

AN INTERFACE WHOSE TIME HAS COME

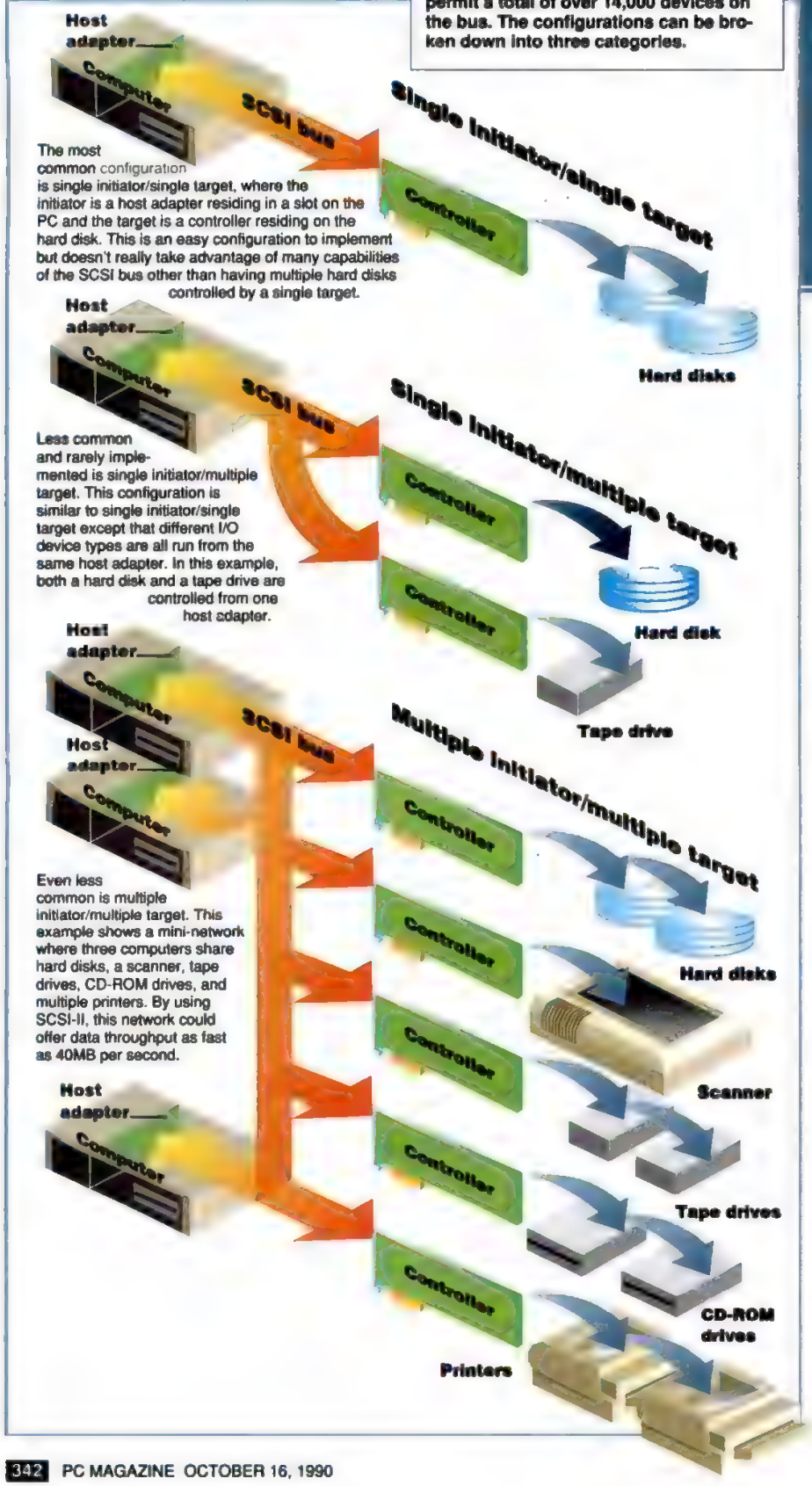
by Robert W. Kane

The time is ripe for SCSI—which just got a seal of approval from IBM. With SCSI, you can add up to seven devices off one host adapter, making it the right bus for the current crop of 386 and 486 PCs.

When IBM announced on March 20, 1990 that its newest Micro Channel computers operating in file server environments would incorporate a Small Computer Systems Interface (SCSI) adapter, many people in the computer industry stood up and took notice. IBM was endorsing an interface standard that had its roots in mainframe machines almost 30 years old for its latest and greatest PS/2. Did IBM teach this old interface new tricks or has it just rediscovered the wheel? The answer lies in today's high-performance PC architecture. With the advent of MCA, EISA, and the 486, SCSI is an interface whose

SCSI Bus Configurations

The SCSI bus has a myriad of configuration possibilities, which, in theory, can permit a total of over 14,000 devices on the bus. The configurations can be broken down into three categories.



The most common configuration is single initiator/single target, where the initiator is a host adapter residing in a slot on the PC and the target is a controller residing on the hard disk. This is an easy configuration to implement but doesn't really take advantage of many capabilities of the SCSI bus other than having multiple hard disks controlled by a single target.

Less common and rarely implemented is single initiator/multiple target. This configuration is similar to single initiator/single target except that different I/O device types are all run from the same host adapter. In this example, both a hard disk and a tape drive are controlled from one host adapter.

Even less common is multiple initiator/multiple target. This example shows a mini-network where three computers share hard disks, a scanner, tape drives, CD-ROM drives, and multiple printers. By using SCSI-II, this network could offer data throughput as fast as 40MB per second.

Benefits of the SCSI Bus

by Robert W. Kane

SCSI enjoys several benefits over other interfaces. In theory, the SCSI bus can support over 14,000 devices. With Disconnect/Reconnect, devices can share the SCSI bus efficiently. And with command queuing, I/O requests are processed more efficiently.

THIS THING CALLED SCSI

SCSI is used in a variety of applications from disk drives and tape backup systems to printers, CD-ROMs, and even more eclectic I/O devices. The primary concept—and main benefit—of SCSI is that it enables many different peripherals to share a common I/O bus. The idea can be traced back to the 1960s when IBM's 360 mainframe machine had an I/O bus that could talk to several different peripheral devices simultaneously.

Over the years, this IBM bus, which became known as the OEM Channel, was modified, enhanced, and presented to the American National Standards Institute (ANSI) for adoption as a standard I/O bus for peripheral devices. Because of the proprietary nature of the OEM Channel, the ANSI committee rejected it, citing the need for a commercially standard parallel I/O bus.

In the early 1980s, a disk drive manufacturer, Shugart Associates, developed its own parallel I/O interface called SASI for Shugart Associates System Interface. When this specification was finalized, it was released to several different manufacturers and enjoyed commercial success. In 1982, SASI was presented to ANSI as a basis for a standard. Because of the commercial success and widespread market use of SASI, ANSI formalized and extended the SASI specification and changed the name to SCSI (in part to separate the specification from any one vendor in particular). But it wasn't until June 23, 1986 that SCSI was formally adopted by ANSI. In fact, the forward to the standard (which is not an official part of the draft), states that "many existing SASI devices are SCSI compatible."

Disconnect/Reconnect

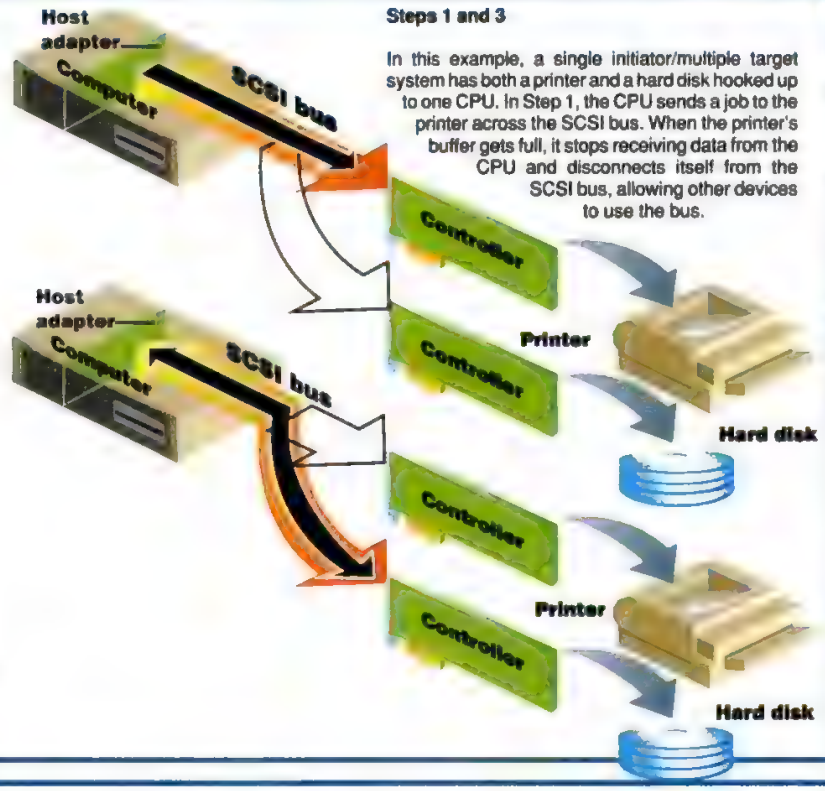
Because SCSI allows you to get the most out of a single I/O bus, it is the best choice for connecting multiple peripheral devices. With Disconnect/Reconnect, idle bus time is turned into bus throughput.

Steps 1 and 3

In this example, a single initiator/multiple target system has both a printer and a hard disk hooked up to one CPU. In Step 1, the CPU sends a job to the printer across the SCSI bus. When the printer's buffer gets full, it stops receiving data from the CPU and disconnects itself from the SCSI bus, allowing other devices to use the bus.

Step 2

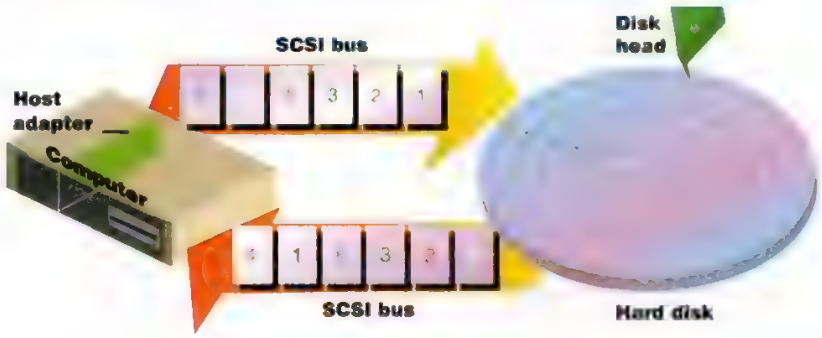
Step 2 proceeds with the CPU reading information from the disk drive while the printer continues to process information in its buffer. When the disk read is over and the printer's buffer has been emptied, the printer reconnects to the SCSI bus (Step 3) to receive more data until the print job is over.



Command Queuing

SCSI processes I/O requests logically, making it more efficient than other interface schemes. SCSI's command queuing capability permits data to be recalled from attached peripherals in the fastest possible way.

Here, six disk read requests are being made from the CPU. The data is scattered all over the disk and is represented by different colors. At the time these six requests come in, the disk drive head is positioned over the outermost track. Once all six commands have been received, the drive locates the head and the requested data so the head makes only one pass over the disk's surface, starting from the outermost track and moving all the way to the inner track.



The main advantages over the original SASI are:

- An electrical option that allows devices to be cabled up to 25 meters from the host adapter.
- Synchronous data transfers permitting throughput rates of 3MB to 4MB per second over the SCSI bus.
- An optional extended command set allowing the use of very large capacity storage devices.
- Command sets for tape drives, printers, processors, and optical drives.

HISTORY LESSON OVER—LET'S GET TO WORK

So why now for SCSI? A big advantage that SCSI enjoys over other I/O interface strategies (e.g. ESDI and ST-506) is that up to eight different SCSI devices can be connected to one SCSI bus. Years ago when PCs had only floppy disks and the occasional hard disk, this type of interface strategy seemed overkill. But today, with the advent of multiple hard disks, drive arrays, optical drives, high-speed printers, and the myriad of other peripheral devices, both tangible and those yet to be developed, an interface strategy that doesn't require separate adapters for every device makes more sense.

From a configuration standpoint, it's also more advantageous: adding peripherals to the SCSI bus only requires setting the SCSI ID for that device. For nonSCSI devices, it requires configuring both the interface adapter as well as the new peripheral. What this means is that for the system with a floppy drive, a hard disk, a printer, an optical drive, and a network connection, only one interface card would be required instead of four, leaving bus slots free for those really strange I/O devices.

Another advantage the SCSI bus has over other interfaces is that devices on the bus are logically rather than physically addressed. This serves two purposes. It eliminates any physical limitations a particular CPU imposes on I/O devices, such as the 1024 cylinder limitation PC BIOS places on fixed disk drives. Also, logical addressing eliminates any overhead the host may have in managing physical as-

pects of a device, such as a bad track table. The SCSI controller handles this.

INITIATORS AND TARGETS: WHICH WAY DOES THE BUS GO?

SCSI-supported devices consist of what are called "initiators" and "targets." An initiator is any SCSI device that requests an operation to be performed by another SCSI device. A target is any SCSI device that performs an operation requested by an initiator. An example is the SCSI host adapter (initiator) that resides in the expansion slot of a PC and a SCSI disk drive (target) connected to the other end of the bus. In this instance, the PC requests information from the disk, tells the SCSI adapter to go get it, and the SCSI adapter commands the disk controller to retrieve the data. It's the disk controller's responsibility to know where the data is physically located based upon the request from the host adapter. Once the disk reads the data, the controller sends it back across the SCSI bus to the host adapter, at which point the cycle is complete (see diagram "SCSI Bus Configurations").

But SCSI goes beyond a single initiator/single target configuration. The SCSI bus also allows single initiator/multiple target configurations, where one SCSI adaptor can connect to multiple devices, such as a hard disk and a tape drive. A third configuration lets you have a multiple initiator/multiple target system, which not only permits multiple peripheral devices to share the bus, but also allows multiple hosts to share those same peripheral devices.

Another little known fact of the SCSI bus is the concept of extended messages. Typically, each target on the SCSI bus is tied to a physical device. It is possible, however, to have multiple physical devices hooked to one target. Through a system of extended messages, you could conceivably have 2,048 peripheral devices hooked to a single target—in a single initiator/multiple target system, you could have a total of 14,336 peripheral devices hooked to one SCSI adapter! In theory, this gives the SCSI bus almost unlimited expansion potential. In practice, though, most vendors wind up with just one peripheral device per target.

MAKING CONNECTIONS

While there is potential for many peripheral devices to share one SCSI adapter, only two SCSI devices can communicate over the bus at the same time. How does the bus accommodate the potential traffic that multiple targets can generate? The answer lies in another little known SCSI capability called Disconnect/Reconnect.

Because of the logical addressing of the SCSI bus, devices connected to it don't need the constant supervision required by devices connected to a bus that performs physical addressing. This fact, along with the idea that not all peripheral devices require constant monitoring by the host (such as when a printer is composing an image in its printer memory) frees up traffic across the SCSI bus. In these cases, a peripheral target can Disconnect from the initiator while it is going about its business. This frees the bus so that other attached devices can communicate. When the time comes for the target (printer) to communicate with the initiator (host) to resume its functioning (such as getting more data to the image) the target Reconnects with the initiator and resumes where it left off.

In a single initiator/multiple target system, you could have a total of 14,336 peripheral devices hooked to one SCSI adapter!

In multiple-target SCSI configurations using Disconnect/Reconnect, you can have multiple peripherals competing to use the bus simultaneously. This is analogous to how bus mastering cards in both MCA and EISA systems compete for the system bus. But the winner of the competition for the SCSI bus is decided neither by the user configuration set up in MCA systems nor the round-robin approach taken by EISA systems. Arbitration on the SCSI bus is decided by a target's SCSI ID number. The lower the ID number, the higher the priority the device has on the bus. When two devices compete for the bus, the one with the lower number always wins. This is important when assigning SCSI IDs to a device. For example, a printer should not be given a lower ID number than a hard disk, since it's more critical for CPU operation.

IT'S ALL IN THE COMMANDS

All these features give the SCSI bus tremendous power and flexibility; but a logically addressed bus needs a way to deal with all the devices that could be attached to it in a consistent and non-vendor specific manner. To do this, a common command set was created for different types of devices compatible with the SCSI bus. This command set is generic in terms of what it asks devices to do (e.g. read, write, and print). It is the peripheral vendor's responsibility to implement these commands in their devices and to interpret them. As the SCSI specification states, this command set "aids in the transfer of logical blocks of data across the bus." This command set has become the key to the future success or failure of the SCSI bus.

The true "intelligence" of the SCSI bus is found in a command method called *command queuing*. Without *command queuing*, an initiator can only give a target one assignment at a time. With command queuing, a target can accept multiple commands from one or multiple initiators and then act on those commands. Command queuing is useful in multiuser and multitasking environments such as Unix and OS/2. For example, in a multiuser environment, six users may need to read data off the disk simultaneously. Without command queuing, each request must be processed in the order received, regardless of where the data is located on the disk. This may require the disk heads to jump back and forth across the entire disk surface, wasting time and putting extra wear on the disk mechanism. With command queuing, these requests can be lumped together so that the data closest to the disk heads are read first followed by the data increasingly farther away. This concept, known as "elevator seeking" can dramatically increase the performance of a SCSI disk system.

THE BUS BREAKS DOWN

With everything that SCSI has going for it, why isn't it the dominant I/O interface on the PC today? The answer is also in the SCSI specification for the command set, which led to a proliferation of many different "SCSIs" and defeated the purpose of the SCSI bus as a *standard* interface.

Within the ANSI standard document X3.131-1986 are listings of commands for various I/O device types. The devices listed in this document are:

- Direct-Access Devices (such as hard

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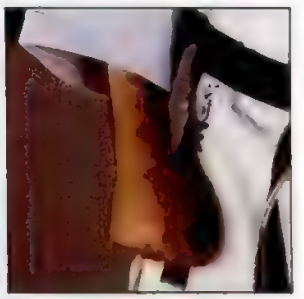

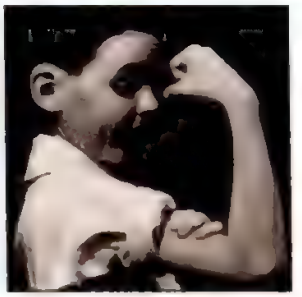

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Each device type has 64 possible operation codes available to it. These codes are classified as being mandatory (required for devices that support device-independent self-configuring software), optional, vendor-specific, or reserved. Of the operation codes listed for direct-access devices, for example, only four of the 64 operation codes are deemed as being mandatory for the device to adhere to the SCSI specification. Four codes are for the device independent, self-configuring type. Twenty-two codes are optional. Twenty-three codes are vendor-specific and 11 codes are reserved.

This means that for a hard disk to be considered a "SCSI" hard disk, all it has to do is implement four commands (Request Sense, Format, Read, and Write). Anything beyond these four commands that a vendor might deem necessary to aid the unit's performance could be implemented and the device could still qualify as SCSI compatible. Often, these "extensions" require a nonstandard host adapter or initiator to be properly supported, thereby making it nonstandard.

In retrospect, there are a number of reasons why SCSI didn't take off as an I/O bus. Certainly, the problem of command set implementation leading to the many different flavors of SCSI didn't help. It only served to confuse and scare off buyers by making them think they were locking themselves into one particular vendor's SCSI. The relaxed implementation of the command set was a concession to all vendors who had their own particular "SCSI" at the time.

Another problem was the PC itself. The ST-506 interface was perfectly suited to the hard and floppy disk storage requirements of the average PC user. Printers were easily attached to parallel and serial ports. If the user needed any additional devices, he could add interface cards to get them up and running. In terms of the number of devices that SCSI could access, its capabilities were simply beyond what most PC users would ever need.

So why didn't SCSI die? The answer is also found inside today's PC. Where once the capabilities of the SCSI bus exceeded the demands that a PC placed on it, the current crop of high-performance 386 and 486 PCs can not only make use of, but demand SCSI bus capabilities. With high performance CPUs coming in small footprint packages, expansion bus slots come at a premium. A one slot solution makes a lot of sense in these diminutive powerhouses. The trend toward more "intelligent" peripheral devices points toward SCSI as well, which offloads many I/O tasks from the processor and permits more CPU time for processor-intensive software such as Unix and OS/2.

Why hasn't SCSI died? The current crop of high-performance 386 and 486 PCs cannot only make use of but demand SCSI bus capabilities.

SCSI II—THE NEXT GENERATION

Given the troubles of the original SCSI specification and the challenges of tomorrow's computer systems, the next logical step, taken on March 9 of this year, was to advance the current SCSI to a higher level and call it—surprise!—SCSI II.

SCSI II brings many new dimensions to the SCSI specification and some features to advance it to a true common I/O bus. The SCSI II specification supports all the devices that SCSI I supports with the additions of scanning devices, optical memory devices (such as magneto-optical disk drives), medium changer devices (like CD-ROM jukeboxes), and communication devices (network interfaces).

SCSI II also widens the bandwidth along the I/O bus. While SCSI I has an 8-bit wide bandwidth, SCSI II provides for a 16- or 32-bit wide bus. (Some people refer to this as "Wide SCSI.") The SCSI bus' timing has also been optimized in SCSI II (sometimes referred to as "Fast SCSI"). When "Wide SCSI" and "Fast SCSI" are combined, throughput rates of 40MB per second are possible—fast enough to keep the world's MCA and EISA buses filled with data.

Most important, SCSI II imposes a more robust command set. For example, with direct access devices, SCSI I deemed that implementation of four commands made a device "SCSI"; SCSI II requires 12 commands for these same devices.

These improvements help the SCSI bus keep pace with the new generation of advanced PC architecture. However, these improvements alone won't be enough to make SCSI the standard I/O interface for the nineties. SCSI still needs more software support and a way to make the disk system more PC specific—both are problems that the industry is addressing.

Currently, a specification is in the works to allow SCSI controllers to emulate an AT hard disk controller. Called the AT Bus Attachment (ATA) for ISA bus computers and Enhanced AT Bus Attachment (EATA) for EISA bus computers, this specification will help in overcoming the differences between the physical addressing that a PC performs with a hard disk and the logical addressing done on the SCSI bus. Without ATA, the physical addresses generated by a PC to access the hard disk must be translated to logical addresses before they can be transmitted across the SCSI bus to the disk drive where they are again translated back to physical addresses using some type of device driver. These translations take time and diminish SCSI's effectiveness.

On the software side, Microsoft Corp. announced at the time of this writing, a layered OS/2 device driver architecture (LADDR) which would provide a standard method for hardware vendors to write SCSI device drivers. Already, the ANSI committee responsible for SCSI II supports LADDR as do major SCSI hardware vendors such as Adaptec, Compaq, Hewlett-Packard, NCR, and Western Digital. With this level of support, you can look for lots of future SCSI developments.

SCSI is an I/O bus whose time has indeed finally come. The technical merits of SCSI are clear: they offer today's high-performance PC architectures the storage and throughput capabilities that these systems demand. The question that remains is whether enough vendors will make their devices "true SCSI" so that all the benefits of the SCSI bus can be realized. And with the support of both IBM and Microsoft, SCSI might turn out to be the dominant I/O bus of the decade.

Robert W. Kane is a project leader at PC Labs.

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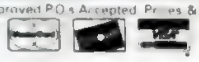

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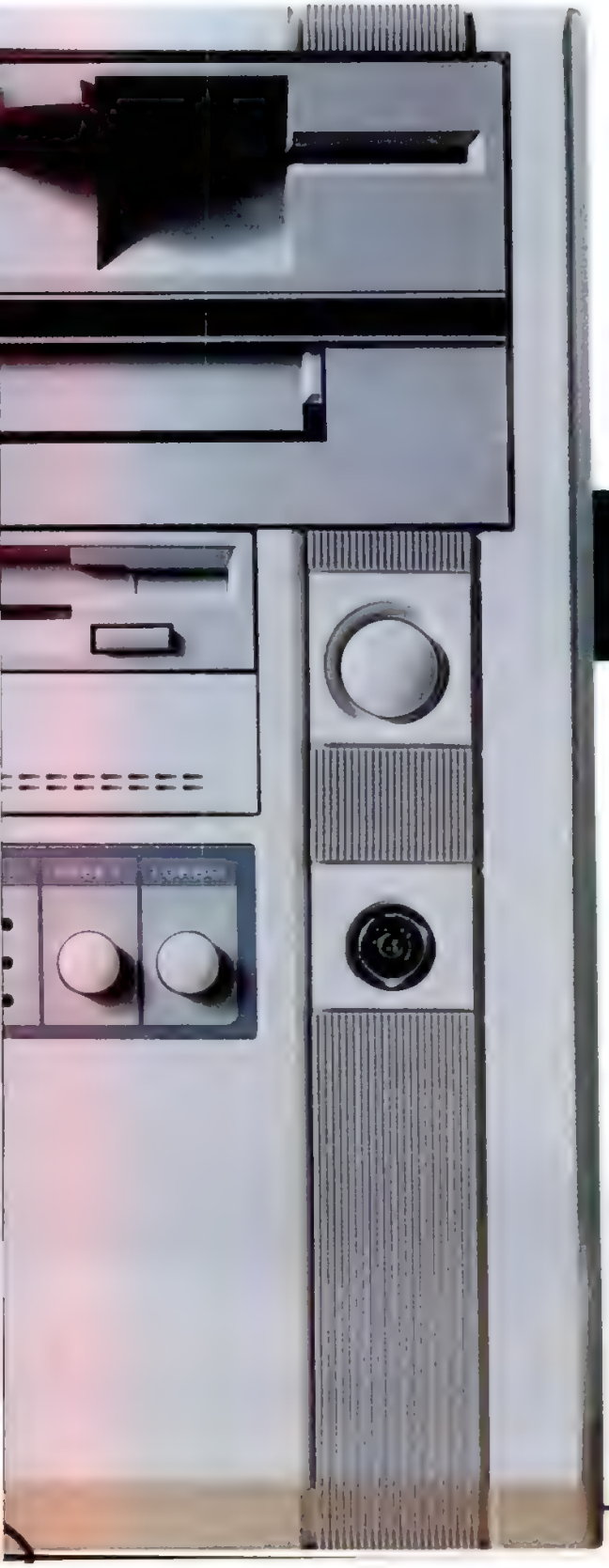

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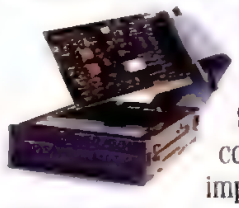

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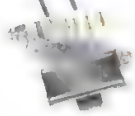

BY FRANK J. DERFLER, JR.

Telephone wire may be your simplest LAN cabling option. These 12 adapters help keep your network reliable and easy to maintain.

What a hassle it is to choose and install the wiring for a LAN! In some cities the cost of labor and wiring materials can top $1,000 for each network node. Ugly LAN wiring ruins the ambience of a carefully designed office suite, and bad wiring can cost a LAN manager his or her job. The best wiring is invisible, reliable, and already in place. Ideally, you choose the wiring once and the choice lasts for years.

Before this year, LAN wiring alternatives were limited to Ethernet and ARCnet coaxial cable and the shielded twisted-pair wiring used in IBM's Token-Ring. But the unshielded twisted-pair wiring residing in the walls of many buildings has always beckoned to LAN managers, particularly because it is already in place. Some companies, including AT&T, Hewlett-Packard, IBM, and Western Digital offered ways to carry LAN traffic over telephone wire, but they provided no standards for wiring or signaling and no guaranteed compatibility.

In late summer or fall of 1990, after three years of meetings, proposals, and compromises, a committee of the Institute of Electrical and Electronics Engineers (IEEE) plans to finalize a specification for running Ethernet-type signaling over twisted-pair wiring. The IEEE warns that companies cannot declare that their products comply with the standard when the standard isn't final, but many companies express confidence that their existing products will comply with the finished standard as they are, or with a fast ROM change.

The IEEE calls the new standard 802.3 10BaseT. Current IEEE 802.3 standards describe carrier-sense multiple access signaling, like Ethernet, used over various wiring systems. 10BaseT employs a signaling speed of 10 megabits per second, a baseband signaling scheme, and twisted-pair wiring. *Baseband signaling* involves sending a direct-current voltage down the wire instead of using radio waves. The radio wave scheme, called *broadband signaling*, attracted some popularity several years ago, but baseband signaling won broader acceptance because it's easier to install and maintain.

Theoretically, the appeal of the widely touted 10BaseT standard comes from claims that it gives LAN managers the option of using installed telephone wiring, saving installation problems and costs. Keeping things simple and inexpensive is a nice objective, but unfortunately the roadblocks you find in most real installations don't let you get there from here. Many organizations don't have enough existing high-quality wiring to support a network installation, so LAN planners find they must pull more wire anyway. Yet other, subtler benefits of 10BaseT make it worth adopting.

> Theoretically, the appeal of the widely touted 10BaseT standard is that it gives LAN managers the option of using installed telephone wiring.

THE BAD NEWS

Wire, wire everywhere and not an inch to link. Many types of telephone wire snake their way through buildings. *Quad*, the wiring found in residences, wraps four parallel wires in one cable. The telephone wiring plants of many older buildings contain thick *multiconductor* cables, used for a key system—one using phones with multiple-line buttons. A few modern buildings were wired with something the industry called *silver satin*. Silver satin cable is flat and typically comes in a silver vinyl jacket. None of these wiring systems—quad, multiconductor, or silver satin—suit modern LAN data services; the wires are not sufficiently resistant to electrical interference.

Buildings wired for modern private branch exchange (PBX) systems in the last five to seven years usually have a cabling system of high-quality *twisted-pair* wiring. Each pair of wires in these cables is twisted together so that the electromagnetic fields in both wires cancel each other and reduce the amount of induced electrical interference and radiation.

This wire will work for LAN transmission, but according to a Western Digital white paper on 10BaseT installations, "The arrangement of twisted pairs at the wall jack in a typical telephone installation is usually not acceptable for network signal transmissions." In other words, the right wires don't go to the right pins in the wall jack to complete the connection to the PC adapter.

Additionally, most PBX wiring installations provide four pairs of wires to the wall jack. The PBX telephone typically uses two of those pairs. Since the 10BaseT connection needs two pairs for itself, there should be enough. But if you have an intercom or other special telephone feature, it often uses the other pair, leaving you no wires for the LAN. Also, a rule of thumb says that 2 or 3 percent of the wire pairs in an installation are bad. When the number of available pairs is already marginal, attrition takes a big toll.

Finally, the twisting of the wires affords some shielding from electromagnetic interference, but elevator motors, fluorescent lights, special telephone options, and many other devices emit signals strong enough to get into the wire and interrupt digital signals. When you install unshielded wires for 10BaseT, you position the wires to avoid these areas of high electromagnetic noise. Preexisting PBX wire runs seldom follow the same guidelines.

So, on the bottom line, you will probably have to pull more telephone wire for a

EDITOR'S CHOICE

•G/EtherTwist
•EtherCard Plus10T

We expect some arguments, but we maintain that the current 10BaseT market consists of products so similar that technical differences among them do not matter much. If so, buyers of these adapters should be able to base their choices on market factors such as cost, availability, company reputation, and special features.

Given those criteria, many buyers would choose G/EtherTwist from Gateway Communications. Gateway offers aggressive prices, a family of adapters for all types of PCs, worldwide availability and support, a strong reputation as a value-added reseller of Novell's *NetWare*, and lots of LEDs, AUI ports, and boot ROM sockets on its boards.

Certainly, however, wise buyers—particularly those not under Novell's thrall—should also patronize Western Digital Corp. for its EtherCard Plus10T line. An international leader in chip technology, Western Digital provides widely available and aggressively priced products, including adapters with the necessary indicators, sockets, and attachments, and a floppy disk full of drivers that is the answer to a network manager's prayers.

If your network is pure Novell, then you can make Gateway your one-stop shop. But if you might want to integrate *LAN Manager*, TCP/IP, and other operating system and transport/session-layer protocols into your facility, then head due west for a Western-style roundup.

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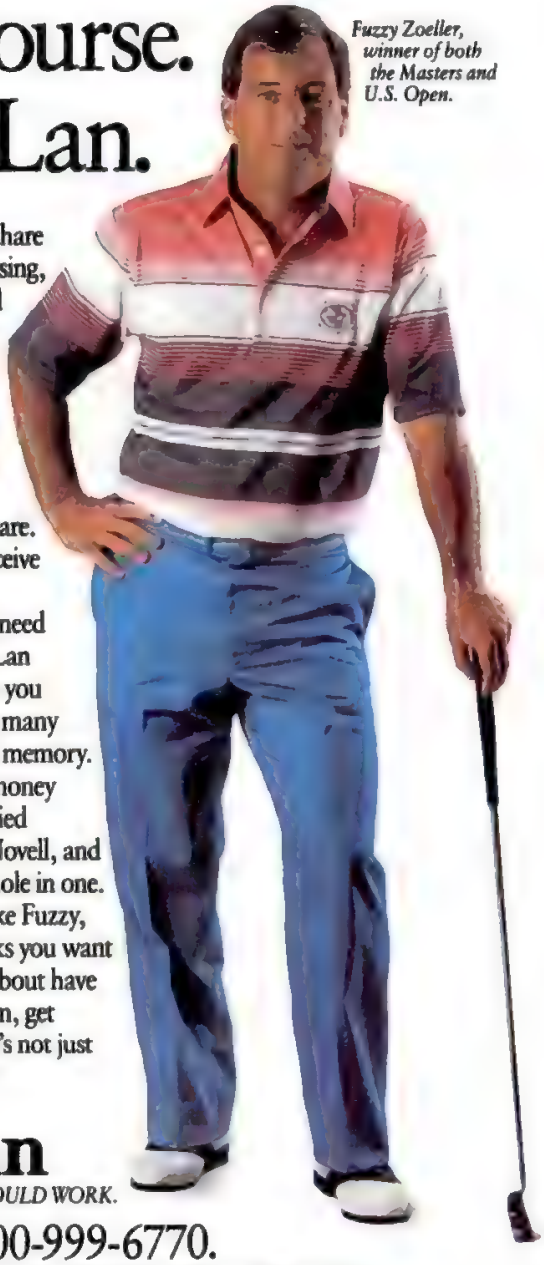

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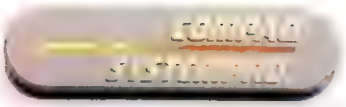

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new 10BaseT installation. Expect to pay about 6 cents a foot, in bulk, for 10BaseT wire, plus the cost of labor and parts such as connection blocks and wall jacks. Also, budget about $3,000 for a wiring hub able to accommodate 20 nodes. This hardware expenditure typically comes to about $150 per port, laying waste to 10BaseT arguments based solely on installation cost.

By comparison, thin Ethernet cable is about 25 cents a foot. With this coaxial cable, you can easily use less than half as much wire as if you had used twisted-pair, since thin Ethernet uses a point-to-point wiring scheme instead of the 10BaseT star wiring plan. Your hardware cost for Ethernet amounts to about $5 per station for coaxial cable connectors, assuming the LAN card vendor supplies the needed T connector for each card. On close inspection, low cost and the use of existing wiring aren't valid reasons to choose 10BaseT, so let's examine the real benefits.

THE GOOD NEWS

Even if you must pull additional twisted-pair wiring to install a 10BaseT LAN, at least you're working with the same wiring used for the telephone system. The technology of twisted-pair wiring, unlike coaxial Ethernet alternatives and Token-Ring's shielded twisted-pair, would be familiar to technicians you already have on staff or on contract. If an installer abides by a few of the IEEE's rules (for example, keeping wire length between a computer and a hub down to a maximum of 330 feet and avoiding sources of electrical noise), the installation is simple. 10BaseT doesn't introduce complex and ugly cabling, wall jacks, and desktop attachments into your office.

As we found in the PC LAN Labs, the strong practical appeal of 10BaseT products lies in their commonality. As with Ethernet, you can safely mix and match 10BaseT adapter cards and wiring hubs from many companies and use them together on the same network. This commonality provides you with multiple sources of supply, confidence in the availability of long-term support, and competitive prices.

Our LAN Labs testing also proved that you don't pay a performance penalty for using 10BaseT twisted-pair. Throughput tests showed performance as consistently good as you get with coaxial Ethernet wiring. Although we include a performance comparison in this review, don't spend a lot of time evaluating the results. The performance differences between the products come largely from the driver software. And companies tend to update their driver software frequently.

To a network manager, the biggest potential advantage of a 10BaseT wiring installation comes from the star wiring scheme. It provides both reliability and centralized management. It's configured like the hub and spokes of a wheel; the wires go from a central wiring hub out to each node. If one wire run is broken or shorted, the node goes out of commission, but the network itself remains operational. In Token-Ring or thin Ethernet wiring schemes, one bad connection at any point takes down the entire network.

During our testing, we completely changed our wiring hubs without taking down the network. We worked quickly to let *NetWare* retry connections, but we swapped between hubs from different companies without a blink or reset. The combination of 10BaseT wiring and *NetWare* tries hard and succeeds in keeping the network working.

The central wiring hub is an ideal place to install a monitoring microprocessor and network management software. Synoptics Communications leads the industry in providing LAN monitoring and management features in a wiring hub. See our review of LAN management software in the November 28, 1989, issue of *PC Magazine* ("LAN Management Systems") for more information on LAN management software—including Synoptics' *LattisNet Network Management System*—in wiring hubs.

HUB CONSIDERATIONS

Wiring hubs, or *concentrators*, have advantages and drawbacks. While the centralized-hub wiring plan improves overall network reliability and prevents the network-wide outages possible under coaxial-cabled Ethernet and Token-Ring, hubs have *trip points* where adding just one more station can require the purchase of a new hub. Also, a faulty hub can break the network into isolated sections.

Assume that you have a network of exactly 30 server and workstation nodes. Since the average hub accepts 10 nodes, you might presume that you need to buy only three hubs. But because you have to interconnect the hubs, four node connec-

MEETING FCC STANDARDS: Can You See the Light?

by Frank J. Derfler, Jr.

A good test for quality in both conventional Ethernet and 10BaseT adapters is to hold them up to the light. If you see light through a clearly defined area on the board, you know that the designer of the board worked with the tough FCC Class B emission standards in mind.

It's no easy task to design 10BaseT boards that meet strict FCC and European specifications on emitted radiation. Engineers know that the harmonics of square waves are infinite. The signals on the wire form square waves and generate harmonics all through the radio spectrum. Designers use a whole variety of innovative techniques, including complex circuits, to filter and reduce these troublesome harmonic emissions.

The light you see when you examine an Ethernet or 10BaseT adapter shines through an area where the normal ground-plane layer of the card has been removed. When high-frequency signals are present on an adapter, design engineers have to work hard to make sure those signals don't become coupled to the computer's chassis. If they are allowed to couple, the AC power line can act like an antenna and spread the unwanted signals far and wide. Isolating certain components from the ground plane is an important technique engineers use to meet FCC Class B certification.

If you can't see the light, the isolated island might just be covered up by additional board layers, but it's more likely that the key section of ground plane is still there. Most designers seem proud of their success in creating a board able to meet strict emission standards and tend to make their work visible. ■

Sometimes it's just not practical to run a cable from a computer to a printer.

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The applications are numerous—from office moves to demonstrations to special needs for temporary staff. You can even connect extra terminals to a larger computer without cabling—a feature which can be invaluable when additional programmers come on board.

There's no software required. A pair of AC DataLinks is all you need. Just connect one to your computer and one to a peripheral. Then plug each into a standard electrical outlet. That's it. You're up and running in minutes.

The AC DataLinks take care of everything: error correction, translation when needed, even adaptors for parallel (Centronics) or serial (RS-232) connections. So you can enjoy virtually universal compatibility between computers and peripherals—even use a parallel printer from a serial port! You can also select an encryption code for each pair of AC DataLinks, providing a high level of data security.

And here's another breakthrough from Verran: the AC DataLink DPS (Dedicated Printer Sharer) which allows up to *seven* computers connected to AC DataLinks to share the same printer. It's like having a printer for each computer—at a fraction of the cost.

Status and queuing information is provided by the AC DataLinks, so you'll enjoy more efficient printer use than ever before. The AC DataLink DPS is suitable for any printer with a parallel port.

Want to free yourself from the ties that bind? See your local computer dealer to learn more about Verran AC DataLink products. Or contact GEC-Marconi for more information.

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tions need to become hub connections (hub A to hub B, hub B to hub C). This means you have to buy four hubs to connect 30 nodes.

The hubs need power. Even if you have uninterruptible power supplies on the server and workstations, you'll still lose network connectivity if the power to the hubs goes out. Hubs don't draw much power, so the lowest-priced UPS will power a closetful of wiring hubs. Power protection for the hubs is one more thing a smart administrator must plan for.

If one hub—say, hub B, which interconnects hubs A and C—should lose power because of a blown fuse or other malfunction, hubs A and C will be isolated from each other. All of the nodes will be able to communicate within each hub, but not between hubs. If a station on hub C wants to use a server on hub A, this outage has the same effect as a total LAN failure. Fortunately, the diagnostic lights on the 10BaseT wiring hub quickly show the location of a problem so that you can reestablish important connections.

REVIEW CRITERIA

In this review, we focus on the 12 companies making 10BaseT network adapter cards. Many of these companies also make wiring centers, hubs, or concentrators—the names vary—but we focused on the adapters for two reasons. First, the wiring hub products aren't coming to the market as quickly as the adapters. Second, the LAN management software associated with the emerging hubs will warrant separate consideration.

Even the LAN adapter products are in short supply. Several additional companies, including D-Link and Racal Inter-Lan, wanted to provide adapters for this review, but the demand for their products prevented them from shipping products to us for our 60- to 90-day testing cycle.

DIFFERENTIATING PRODUCTS

We'll probably anger a few companies by insisting that products in the 10BaseT market have many similar features and often can be used interchangeably. We don't mean to imply that there aren't technical differences, but we do feel that to most buyers the differences between 10BaseT adapters won't matter much. After a few technical considerations, you can safely buy 10BaseT adapters based on price, availability, brand name, and company reputation.

As is often the case with products that have so many similarities, the prices of these cards continue to fall as companies maneuver for position. We had to revise prices frequently during our review cycle. The 8-bit ISA boards range in price from $275 to $495; 16-bit boards from $375 to $595; MCA boards from $375 to $695.

> Because you can mix and match 10BaseT, you don't have to use the same vendors' adapters for the servers and workstations.

The adapters we saw varied on a few practical technical points, such as the number and types of diagnostic lights on each adapter and whether they set communications parameters using jumpers or software. The diagnostic lights are valuable—we avoided several time-consuming troubleshooting sessions during our testing by just looking at the lights that show connection status and activity—but most people will focus on three differentiating factors among these adapters.

The first important factor is the availability of the right software driver interface for whatever LAN file server software you use. All of the adapters we reviewed support *NetWare*, but only a few provide interfaces for Microsoft's *LAN Manager*, Banyan's *VINES*, and other operating systems. Several companies, like Gateway Communications and Western Digital, now support the Network Driver Interface Specification (NDIS), a Microsoft specification for writing hardware-independent drivers. Supporting NDIS provides compatibility with all versions of *LAN Manager* and other operating systems like *VINES*.

Western Digital has the best set of adapter card interfaces, including an excellent implementation of NetBIOS. If you're buying LAN hardware for an organization using various LAN file server systems, you should look at Western Digital's adapters first. Using these adapters lets you standardize on one type of hardware. But if you need only an interface to *NetWare*, the 10BaseT market offers a number of products for you.

The second important consideration is the availability of appropriate adapters for a server such as a 16-bit ISA, 32-bit Micro Channel, bus-mastering, or EISA device. But because you can mix and match 10BaseT, you don't have to use adapters from the same vendors for the servers and workstations.

Some buyers will want to note whether the adapters include an Attachment Unit Interface (AUI) port. The AUI port connects to a device called a transceiver, or medium attachment unit, and allows the cards to be used with thick and thin Ethernet coaxial cables and fiber-optic cables. The port therefore gives you more flexibility and potential for reuse on other wiring schemes. If you have only a 10BaseT connector and no AUI on the board, you can use only the 10BaseT wiring plan.

One interesting note: the designers of these products seem to possess faith in their quality. Warranties of three years are common, and some companies cover their boards for as long as five.

LESS FEAR

Installing a wiring system according to the 10BaseT standards might not initially save you as much money as other LAN wiring alternatives. But the ability to stay operational despite physical wire problems that would crash a coaxial Ethernet network or Token-Ring setup, plus the LAN management advantages of 10BaseT, make it a good option for any modern network installation.

AT&T COMPUTER SYSTEMS

StarLAN 10 NAU

by R. Dennis Boatner

AT&T helped pioneer the 10BaseT revolution four years ago with its StarLAN line of products. Now, with the IEEE nearing a final decision on twisted-pair standards, the company is prepared to remain "the right choice" with its StarLAN 10 network adapter unit (NAU).

The StarLAN line is easy to install and compatible with older AT&T NAUs. Installation requires only the setting of three board-mounted jumpers. In addi-

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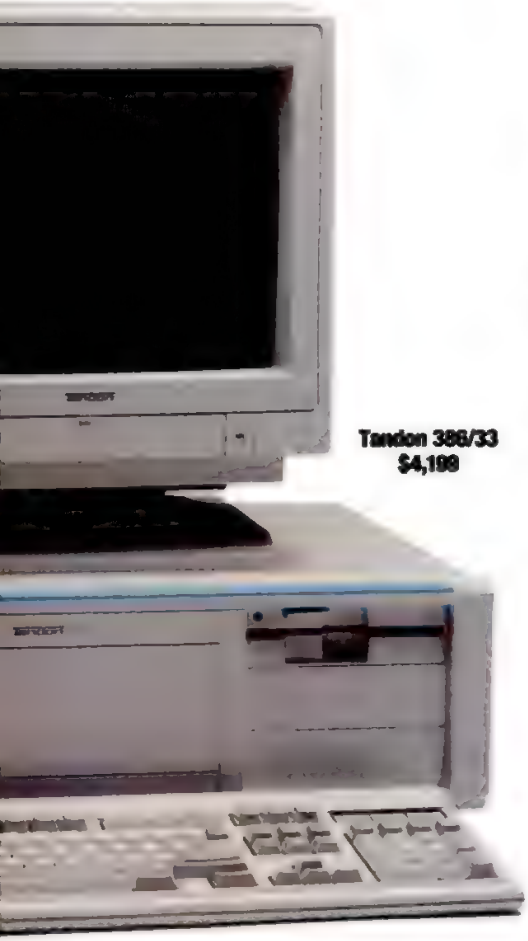

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HARDWARE HUMOR. 486 computers are getting so fast, one software company is coming out with DRAM-amine.

TANDON 386/33 AND 25 STANDARD FEATURES: • Intel 80386 processor, keyboard selectable speed between 8/25 MHz or 8/33 MHz. Socket for Intel 80387 or Weitek math coprocessor. • 1 MB of 32-bit memory; 64 KB static RAM cache. Upgradeable to 16 MB of 32 bit memory. • 5.25-inch high-density, double sided 1.2 MB diskette drive or 3.5-in high density, double sided 1.44 MB diskette drive. • Built-in system setup utility automatically configures memory expansion, diskette drive, security, serial and parallel options. • Universal 101-key enhanced layout keyboard with 12 function keys. • Serial/parallel adapter requires one expansion slot; RS 232-C serial port; IBM compatible bi-directional parallel port. • One 32-bit memory slot; six 16-bit AT compatible slots; one 8-bit XT compatible slot. • 190 watts, fan cooled power supply; switchable to 115 volts or 230 volts. • Built in speaker with programmable IBM-compatible sound. • Dimensions: 21.1 in. wide by 16.3 in. deep by 6.3 in. high. Weight: 39.9 lbs. **Price includes system unit, 110 MB IDE fixed drive, VGA monochrome monitor, 16-bit video card, keyboard, power cord, Tandon MS-DOS software and manual, operating and installation manual. OPTIONS:** 1 and 4 MB memory upgrade kits (to 16 MB); add-in memory daughterboard, Microsoft Windows 3.0 and serial/bus mouse, 80387 math co-processor, 200 MB IDE, 330 MB ESDI fixed disks, VGA and super VGA color monitors, graphics accelerator card, 2400 baud modems, Ethernet cards, laser printers.

*Microsoft Windows 3.0 and serial mouse are included with all configurations of 2 MB or more.

TANDON 486/25 STANDARD FEATURES: Intel 80486 processor, keyboard selectable speed between 8 and 25 MHz. Socket for Weitek 4167 math coprocessor. • 2 MB of 64-bit memory; external 64 KB static RAM cache, PowerPoster write buffer. Upgradeable to 64 MB of 64 bit memory. • 5.25-inch high-density, double sided 1.2 MB diskette drive or 3.5-inch high-density, double sided 1.44 MB diskette drive. • Built-in system setup utility automatically configures memory expansion, diskette drive, security, serial and parallel options. • Universal 101-key enhanced layout keyboard with 12 function keys. • Two RS-212-C serial ports and one IBM compatible bi-directional parallel port. • Six 32-bit EISA slots, two 16-bit AT compatible slots. • 230 watts, fan cooled power supply; switchable to 115 volts or 230 volts. • Built in speaker with programmable IBM-compatible sound. •

Tandon 486/25
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Dimensions: 21.1 in. wide by 16.3 in. deep by 6.3 in. high. Weight: 39.9 lbs. **Price includes system unit, 110 MB IDE fixed drive, VGA monochrome monitor, 16-bit video card, keyboard, power cord, Tandon MS-DOS software and manual, Microsoft Windows 3.0 and serial mouse, operating and installation manual. OPTIONS:** 2 and 8 MB memory upgrade kits (to 64 MB); add-in memory daughterboard, 200 MB IDE, 330 MB 600 MB and 1 GB SCSI fixed disks, 650 MB ISO-approved optical drive, and cartridge, VGA and super VGA color monitors, graphics accelerator card, 2400 baud modems, Ethernet cards, laser printers.

TANDON TOWER 486/25 STANDARD FEATURES: Intel 80486 processor, keyboard selectable speed between 8 and 25 MHz. Socket for Weitek 4167 math coprocessor. • 2 MB of 64-bit memory; external 64 KB static RAM cache, PowerPoster write buffer. Upgradeable to 64 MB of 64 bit memory. • 5.25-inch high-denstiy, double sided 1.2 MB diskette drive and 3.5-inch high-density, double sided 1.44 MB diskette drive. • Built-in system setup utility

Tandon Tower 386
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automatically configures memory expansion, diskette drive, security, serial and parallel options. • Universal 101-key enhanced layout keyboard with 12 function keys. • Two RS-212-C serial ports and one IBM compatible bi-directional parallel port. • Six 32-bit EISA slots, two 16-bit AT compatible slots. • 250 watts, fan cooled power supply; switchable to 115 volts or 230 volts. • Built in speaker with programmable IBM-compatible sound. • Dimensions: 10.2 in. wide by 19.6 in. deep by 26.1 in. high. Weight: 70 lbs. **Price includes system unit, 110 MB IDE fixed drive, VGA monochrome monitor, 16-bit video card, keyboard, power cord, Tandon MS-DOS software and manual, Microsoft Windows 3.0 and serial mouse, operating and installation manual. OPTIONS:** 2 and 8 MB memory upgrade kits (to 64 MB); add-in memory daughterboard, Microsoft Windows 3.0 and serial/bus mouse, 200 MB IDE, 330 MB, 600 MB and 1 GB SCSI fixed disks, 650 MB ISO-approved optical drive, VGA and super VGA color monitors, graphics accelerator card, 2400 baud modems, Ethernet cards, laser printers.

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tion, a single slide jumper can convert AT&T's latest adapters from the older StarLAN 10, which ran at 1 megabit per second, to the IEEE's 10-Mbps standard.

The $445 StarLAN 10 Network Adapter Unit is an 8-bit card using an ISA bus. An alternative unit, the StarLAN/MC, uses Micro Channel architecture and sells for the same price. AT&T doesn't make a 16-bit adapter because it believes that a 16-bit card would improve throughput by only 5 percent under heavily loaded conditions.

The adapter comes in file server and workstation versions that include 64K and 16K of RAM respectively. The larger amount of RAM improves buffer capacity and ensures that a busy adapter won't drop packets. You select from two I/O-base and 20 base-memory address options. Slide jumpers help you pick any of the five IRQ settings available on the board.

Unlike others we tested that rely on surface-mount or a combination of surface-mount and gate-array techniques, the AT&T board uses through-hole technology. The card conforms to the 10BaseT standard of 330 feet between connections. In addition, a section of the ground plane is isolated in order to reduce radiation emitted from the card. This feature helps AT&T meet FCC Class B certification as well as UL approval standards; it also improves transmission and reception capabilities.

AT&T uses its own chip, a T7210 Manchester Decoder and Interface Chip (MDIC), with the T7240 Twisted-Pair Port Transceiver (TPORT) chip set in both units. The StarLAN 10 adapter works with an Intel 82586 16-bit controller as its main processor.

The card leaves out some features while including others. It has no LEDs to display link information, but it does contain a link-integrity-enable switch that enables the link to take place; it is similar to the way a jumper setting works. This switch gives StarLAN 10 backward compatibility with earlier AT&T products.

The card also lacks an AUI connector on the back panel (though an RJ-45 connector comes standard). Because the AUI connector resides on the hub only, you don't get as much versatility as some adapters give you. If you already have standard Ethernet cards with AUI ports and want to use 10BaseT wiring, however, AT&T sells the StarLAN 10 AUI Adapter, a 3.5- by 1.5-inch transceiver for 10BaseT that includes an RJ-45 connector and four LEDs showing transmit, collision, jabber, and RX/Link integrity. It sells for $175. For users on fiber-optic networks, AT&T makes a fiber NAU (adapter board) that transmits up to 1 kilometer and sells for $500. A fiber hub that handles eight devices sells for $2,395.

While StarLAN 10 does not provide support for diskless workstations, it does have drivers for various network operating systems. These include Novell's *NetWare*, Banyan's *VINES*, NDIS-conforming adapters, and of course *AT&T StarGROUP*, AT&T's implementation of Microsoft's *LAN Manager*. On these systems, you can use the StarLAN 10 adapter, a full-length card with an 8-bit interface.

AT&T markets other products that complement its StarLAN 10 card. The StarLAN wire hub, for instance, is a multiport repeater that comes with ten ports and an AUI port and sells for $1,895. AT&T also makes a StarLAN coax adapter that handles both thin Ethernet and 10BaseT products and functions as a true active repeater. It contains four LEDs for traffic and collision monitoring and sells for $795.

AT&T offers a three-year warranty for both product and technical support. The company has technical service centers around the world. Its intimate knowledge of twisted-pair wiring and leadership in the 10BaseT field make AT&T a good choice for your 10BaseT supplier.

FACT FILE

StarLAN 10 NAU
AT&T Computer Systems, One Speedwell Ave., Morristown, NJ 07960; (800) 247-1212, (201) 957-2000.
List Price: StarLAN 10 card, $445; StarLAN/MC card, $445.
Requires: IBM PC, XT, AT, 386, 486, or PS/2 MCA compatible.
In Short: AT&T, long a leader in LAN communications, has found a definite place with its 10BaseT product line. However, the configurations have some limitations in the diskless workstation area and also in the networks they support. Although the prices are high, AT&T's warranty is strong and support is excellent. Don't overlook this product.

CIRCLE 409 ON READER SERVICE CARD

CABLETRON SYSTEMS INC.

E2010/E3010 Ethernet Cards MMAC3/MMAC8 Hub Chassis

by C. G. Milligan

Cabletron Systems' cards and hubs offer a complete solution to your connectivity needs. The company's versatile products can make a wide variety of coaxial and fiber-optic network connections. However, we found compatibility problems between the vendor's adapters and some PCs that prevented us from completing our benchmark tests. The company could not deliver working cards in time for our review, but a fix was in the works at the time we went to press.

The $495 E2010 twisted-pair Ethernet card is designed for the 16-bit bus of an IBM AT or compatible system. You have to set jumpers to configure the address and I/O ports. The $649 E3010 card uses the Micro Channel bus design of the IBM PS/2 systems. The PS/2's system configuration utility accomplishes the E3010 setup, and Cabletron provides with the card the required ADF (automatic definition file) that helps the PS/2 identify the hardware connected to it. Both cards include a slide switch to select either RJ-45 or AUI connections.

The two cards use the standard National Semiconductor Ethernet chip set and 16K of dual-ported buffer RAM. A menu-driven diagnostic program helps ferret out any problems in the cards, checking to see if the adapter responds to commands from the software. In addition, each card has four labeled LEDs that indicate the link, collision, transmit, and receive status of the network connection. Cabletron also installs a replaceable fuse in the cards for extra protection from transient voltages that might, through accident or miswiring, be imposed on the LAN wiring.

On the down side, the Cabletron ISA board does not work with all IBM-compatible PCs, including our test-bed of Dell System 200 computers. Cabletron's technical support team told us that the company knows of problems between its adapter and certain PCs. Apparently Dell fits that category. Cabletron follows the

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CIRCLE 293 ON READER SERVICE CARD

FACT FILE

E2010 (AT) and E3010 (MCA) Ethernet Cards
MMAC3 and MMAC8 Hub Chassis
Cabletron Systems Inc., 35 Industrial Way, Rochester, NH 03867; (603) 332-9400 (tech support).
List Price: E2010, $495; E3010, $649; MMAC3 three-slot hub chassis, $750; MMAC8 eight-slot hub chassis, $895; coaxial Ethernet module, $1,875; twisted-pair module, $2,275; IRM AUI module, $2,275.
Requires: IBM AT, 386, or compatible; IBM PS/2 Micro Channel or compatible.
In Short: Cabletron Systems' AT and MCA bus cards use the National Semiconductor chip set and 16K of dual-ported buffer RAM. The hubs, which can accommodate optional module cards to give you coaxial, twisted-pair, AUI, and fiber-optic connectors, come in two sizes: MMAC3 for three modules, MMAC8 for eight. The cards and hubs are certified for FCC Class A.

CIRCLE 410 ON READER SERVICE CARD

odd practice of installing a device driver for its boards in the CONFIG.SYS file, even under *NetWare*. Whether or not the driver is related to the board's operational problems is unclear; however, Cabletron's is only the second adapter in two years that wouldn't run in the LAN Labs' Dell machines.

Also on the down side, Cabletron does not provide a chip socket for an optional boot PROM. Lack of this feature on the cards precludes their use in diskless workstations.

You can configure Cabletron's hub system to meet the needs of your network. The hubs, which come equipped with the *Remote LANView-PC* software package, work with any company's adapters and give you the ability to merge 10BaseT and fiber-optic media; they also provide sophisticated menu-driven diagnostics.

In addition, large cards, or modules, provide the hardware to make the connections you need. The hub chassis itself comes in two sizes: the MMAC3 hub chassis can hold up to three module cards, while the MMAC8 chassis holds eight. The array of module cards that Cabletron sells extends this versatility. The $2,275 10BaseT module contains six RJ-45 connectors. The $2,275 IRM-AUI port module includes one DB9 console port (a 9-pin connector with receive and transmit, ground and positive lines), two AUI ports, and one BNC coaxial MAU port. Cabletron also has a coaxial-based module for $1,875, a 12-port fiber-optic module for $2,850, and a 24-port fiber-optic module for $4,000.

Cabletron provides a complete solution for 10BaseT and other network alternatives with its FCC Class A certified cards and hubs. The company has a reputation for solid hardware and has a widely installed base of systems.

DAVID SYSTEMS INC.

David ExpressNET LAN, David VolksNET LAN

by R. Dennis Boatner

David Systems markets both adapters and wire hubs for 10BaseT systems. The company prices its Ether-T PC/AT Adapters at $350 for ISA and $445 for MCA models. Since Gateway Communications actually manufactures the cards for David Systems, we have included information about David Systems' adapters within the Gateway G/EtherTwist review that appears later in this article.

The David Systems hub units, the David ExpressNET LAN and the David VolksNET LAN, differ from the Gateway products, so we will discuss them in some detail here. Although both hub units are 10BaseT compatible, the ExpressNET LAN hub includes a few extra features such as diagnostics, statistical reporting, and remote attachment control. The VolksNET LAN hub is a plain vanilla device sold at a lower cost. The main difference between the two units is that the ExpressNET is expandable, whereas the VolksNET is not.

FOR SMALL WORKGROUPS

The David VolksNET LAN hub sells for $1,199. Designed for small workgroups of 6 to 40 people, the VolksNET hub can be desk mounted or set up to stand in a corner. If you buy it, you'll need a $149 multiport RJ-45 connector, often called a harmonica, or some other method—such as a punch-down block—of connecting the hub's 50-pin socket to the facility's wiring system.

The ExpressNET LAN hub sells for $2,495 and, unlike the VolksNET, can provide remote diagnostics and management of the individual ports. The ExpressNET also allows you to use a concentrator to increase the number of ports each hub holds. David's own concentrator can support up to 132 ports and sells for $1,500; a five-slot model supports up to 48 ports and sells for $1,200.

Both hubs support the standard 100-meter or 330-foot wiring configuration from the PC to the hub. In addition, each contains LED lights to indicate link activity and link status. David Systems products include a two-year warranty supported by both VAR and factory service centers. The technical support is unlimited and free except for the long-distance call.

The people at David Systems come from the telephone industry and thus understand the complexities of building wiring systems. The company's hubs fit nicely into telephone wiring closets, with 50-pin cable adapters that make it easy to intermix Ethernet, twisted-pair, and fiber-optic wiring without going through another layer of modular RJ-45 plugs. These hubs and adapters are nicely priced products from a company that understands 10BaseT.

FACT FILE

David ExpressNET LAN
David VolksNET LAN
David Systems Inc., 701 East Evelyn Ave., Sunnyvale, CA 94086; (408) 720-8000.
List Price: David VolksNET LAN hub, $1,199; David ExpressNET LAN hub, $2,495; Ether-T PC, $350; Ether-T AT, $445; Ether-T MC, $475.
Requires: Hubs: Any 10BaseT-conforming network adapters and wiring. Adapters: IBM PC, XT, AT, 386, 486 or compatible.
In Short: David Systems resells the high-quality Gateway 10BaseT adapters and also has its own line of wiring hubs. Pricing is competitive and support seems adequate. The two hubs offer good price and performance alternatives.

CIRCLE 411 ON READER SERVICE CARD

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Product Class	Low-profile desktop	Small desktop
The User	For the user who needs 386SX performance and requires specific network features	For the general business user considering 286 personal computers
Microprocessor Clock Speed	32-/16-bit 386SX 16-MHz	32-/16-bit 386SX 16-MHz
Coprocessors Supported	16-MHz 387SX	16-MHz 387SX
Expansion Slots Available Type	3 (2) 8-/16-bit ISA (1) high-speed memory	5 (4) 8-/16-bit ISA (1) high-speed memory
Standard Memory Maximum Memory	1 MB 16 MB	2 MB 13 MB
Storage Capabilities 3½-inch Diskette Drive	1.44-MB standard	1.44-MB standard, second optional
5¼-inch Diskette Drives	1.2-MB optional	1.2-MB optional 360-Kbyte optional
Standard Fixed Disk Drives	40-MB	84-MB 40-MB
Optional Fixed Disk Drives *Fixed Disk Expansion Unit only **Supported in Model 1 only	120-MB 60-MB 40-MB 20-MB	Fixed Disk Expansion Unit (Model 300) 320-MB** 84-MB 300-MB* 40-MB 110-MB 20-MB
Maximum Storage Capacity	120 MB	1.2 GB
Tape Drives (Optional)	N/A	150-/250-MB, 80-/120-MB, or 60-MB
Operating Systems MS-DOS and MS OS/2 are available from Compaq	MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386	MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386
Display (Optional)	Video Graphics Color Video Graphics Monochrome	Advanced Graphics Color Video Graphics Color Video Graphics Monochrome
Video Controllers	Video Graphics (standard) 640 × 480 graphics 720 × 400 text 132-column text support	Video Graphics (standard) 640 × 480 graphics 720 × 400 text Advanced Graphics 1024 (optional) 1024 × 768 graphics 720 × 400 text
Keyboard	Enhanced Keyboard	Enhanced Keyboard
Dimensions	15.0"W × 14.9"D × 3.9"H (38.1cmW × 37.8cmD × 9.9cmH)	15.8"W × 14.8"D × 5.9"H (40.1cmW × 37.5cmD × 14.9cmH)
Additional Options ‡U.S. and Canada.	2400-Baud Internal Modem‡	2400-Baud Internal Modem‡

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32-/16-bit 386SX 20-MHz with 4K Cache	32-bit 386 20-MHz with 32K Cache	32-bit 386 25-MHz with 32K Cache	32-bit 386 33-MHz with 64K Cache
20-MHz 387SX	20-MHz 387 or Weitek 3167	25-MHz 387 or Weitek 3167	33-MHz 387 and 33-MHz Weitek 3167
4 (4) 8-/16-bit ISA	5 (4) 8-/16-bit ISA (1) 32-bit memory	5 (4) 8-/16-bit ISA (1) 32-bit memory	7-8 (7) 8-/16-/32-bit EISA (1) 32-bit memory
2 MB 16 MB	4 MB 16 MB	4 MB 16 MB	4 MB 100 MB
1.44-MB standard, second optional	1.44-MB standard, second optional	1.44-MB standard, second optional	1.44-MB standard, second optional
1.2-MB optional 360-Kbyte optional	1.2-MB optional 360-Kbyte optional	1.2-MB optional 360-Kbyte optional	1.2-MB optional 360-Kbyte optional
120-MB 60-MB	110-MB 40-MB	120-MB 60-MB	650-MB 320-MB 120-MB
Fixed Disk Expansion Unit (Model 650 & 300) 650-MB* 120-MB 300-MB* 60-MB 210-MB 40-MB	Fixed Disk Expansion Unit (Model 300) 320-MB** 84-MB 300-MB* 40-MB 110-MB 20-MB	Fixed Disk Expansion Unit (Model 300) 320-MB** 84-MB 300-MB* 60-MB 120-MB 40-MB 110-MB	Fixed Disk Expansion Unit (Model 650 & 300) 650-MB 210-MB 320-MB 120-MB 300-MB* 420-MB Drive Array Pair 240-MB Drive Array Pair
2.6 GB	1.2 GB	1.2 GB	2.6 GB
150-/250-MB, 80-/120-MB or 60-MB	150-/250-MB, 80-/120-MB or 60-MB	150-/250-MB, 80-/120-MB or 60-MB	320-/525-MB, 150-/250-MB or 80-/120-MB
MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386	MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386	MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386	MS-DOS, MS OS/2, Novell NetWare, Microsoft LAN Manager, Banyan VINES, SCO UNIX/386
Advanced Graphics Color Video Graphics Color Video Graphics Monochrome	Advanced Graphics Color Video Graphics Color Video Graphics Monochrome	Advanced Graphics Color Video Graphics Color Video Graphics Monochrome	Advanced Graphics Color Video Graphics Color Video Graphics Monochrome
Video Graphics (standard) 640 × 480 graphics 720 × 400 text 132-column text support Advanced Graphics 1024 (optional) 1024 × 768 graphics 720 × 400 text	Video Graphics (standard) 640 × 480 graphics 720 × 400 text Advanced Graphics 1024 (optional) 1024 × 768 graphics 720 × 400 text	Video Graphics (standard) 640 × 480 graphics 720 × 400 text Advanced Graphics 1024 (optional) 1024 × 768 graphics 720 × 400 text	Video Graphics (standard) 640 × 480 graphics 720 × 400 text 132-column text support Advanced Graphics 1024 (optional) 1024 × 768 graphics 720 × 400 text
Enhanced Keyboard	Enhanced Keyboard	Enhanced Keyboard	Enhanced Keyboard
15.8"W × 14.8"D × 5.9"H (40.1cmW × 37.5cmD × 14.9cmH)	15.8"W × 14.8"D × 5.9"H (40.1cmW × 37.5cmD × 14.9cmH)	15.8"W × 14.8"D × 5.9"H (40.1cmW × 37.5cmD × 14.9cmH)	19.2"W × 17.7"D × 6.5"H (48.8cmW × 45.0cmD × 16.6cmH)
2400-Baud Internal Modem‡	2400-Baud Internal Modem‡	2400-Baud Internal Modem‡	2400-Baud Internal Modem‡

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Advanced Productivity	Financial Analysis Database Presentation Graphics Small LAN File Server	DX (32-bit) Performance Moderate Expansion	COMPAQ DESKPRO 386/25e COMPAQ DESKPRO 386/20e
Mainstream Productivity	Word Processing Spreadsheets Database Stand-alone or Networked PCs	Moderate Performance Specific Network Features Minimum Expansion	COMPAQ DESKPRO 386s/20 COMPAQ DESKPRO 386s COMPAQ DESKPRO 386N

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DCA 10NET COMMUNICATIONS

10BASE Twisted-Pair Adapter

by R. Dennis Boatner

DCA 10NET Communications recently released its entry into the 10BaseT arena. The 10BASE Twisted-Pair Adapter is an 8-bit ISA card selling for $425. DCA also plans to have an MCA card in release by the time you read this. Its projected price will be $475. The company has had these 10BaseT products under development since early this year, less time than many of its competitors. Prior to entering the 10BaseT field, it established a presence in the Ethernet market dating back to 1988.

DCA's adapter, like Hewlett-Packard's, uses only a smaller RJ-11 connector on the adapter card instead of the more flexible RJ-45 and AUI connectors, which may limit the expandability of your network. As a standard feature, the card uses gate-array technology with a built-in transceiver that provides the connection to the twisted-pair medium. Two LEDs appear on the rear of the card: a green light to indicate link status and a red light to monitor transmit functions. The full-length card is versatile enough to fit into either an 8- or 16-bit slot.

INSTALLATION

We saw the manual only in its draft stage, but it already had an index and table of contents, a trouble-shooting guide, and was written in a language that would be understandable to nonprogrammers. It's laid out in such a way that even a novice in the field of 10BaseT will understand the system after reading it. It walks you through installation with diagrams and easy-to-understand language. It also includes simple instructions on how to install the card, along with the transceiver and hub units.

A menu-driven program helps you install the 10NET driver software, listing the current IRQ setting, the port address, and the size of the shared memory window as you go along. The installation program and driver software come in both 5.25- and 3.5-inch formats.

The DCA 10NET card contains 32K of dual-port RAM and conforms to the IEEE 10BaseT standard of a maximum wire length of 100 meters, or 330 feet. It also supports such standard systems as *10NET Plus, LAN Manager*, NDIS, *NetWare 286*, and NetBIOS networking software drivers. Currently it does not support *NetWare 386*. There is no boot PROM available at this time, thus eliminating the use of a diskless workstation.

Nevertheless, 10NET does provide numerous devices for network expansion. For example, it offers a $2,200 10BASE Twisted-Pair Concentrator, which offers expansion through 11 twisted-pair connections, one fiber-optic connector, and one AUI port. One of the twisted-pair ports is dedicated to daisy-chaining connections between hubs to make them part of the same network, while the other ten ports allow PC connections. In addition to its connector ports, it also features LEDs indicating both jabber and receive, plus LEDs showing transmit and receive status. While the price of this hub may seem a little higher than usual, its fiber-optic capability gives it the advantage of connecting to other hubs over a distance of several kilometers.

DCA 10NET also markets a 3- by 4- by 1.25-inch 10BASE twisted-pair transceiver. The transceiver includes such features as a power-on and transmit indicator, a link status and receive indicator, and LEDs that display collision and jabber conditions on the network. The unit also has a signal quality error (SQE) switch that verifies the link between the AUI port on the hub and the transceiver. The connector sells for $195 and transfers data as rapidly as 10 megabits per second.

Another of the company's 10BaseT products is a 10-megabit fiber-optic card called the 10NET 10-Meg Fiber Optic, which costs $795. DCA 10NET continues to sell the standard Ethernet adapter cards and hubs. It also offers two types of bridges: the 10NET Plus LAN Bridge lets you connect a 10BASE twisted-pair LAN to a variety of different networks, including another 10BaseT LAN, a 10NET Bus/StarLAN with 1-megabit twisted-pair cabling, a 1- or 10-megabit fiber-optic LAN, or a 10NET LAN with standard Ethernet coaxial cable. The bridge sells for $595. The second bridge is a NetBIOS-only bridge that sells for $295. It allows you to connect a 10NET network to a NetBIOS-compatible third-party network like the IBM Token-Ring or Microsoft's *LAN Manager*.

WARRANTY AND OTHER PRODUCTS

DCA 10NET warrants its cards for one year against defects in materials and workmanship. It also provides free unlimited technical support at a toll-free number. Tech support comes both from the home office in Dayton, Ohio, and through a worldwide dealer network.

Perhaps the strongest appeal of the 10BaseT products from DCA 10NET is that they are part of a family of products. The company markets its own operating system, adapters conforming to the federal government's TEMPEST standards for emission security, and other LAN applications such as electronic mail.

DCA 10NET can be an economical place for one-stop LAN shopping. Its pricing is competitive with other 10BaseT manufacturers. When combined with its 10NET PLUS operating system (single-user version, $179; 100-user version, $5,000), DCA 10NET starts to look like the first full-featured 10BaseT company. Even though it is departing from other manufacturers that use RJ-45 and AUI connections on their cards, it does offer other features like the e-mail, operating system, and LAN bridges at a more competitive price than other products we reviewed. This helps offset the limited direction the company originally took in the production of its card.

FACT FILE

10BASE Twisted-Pair Adapter
DCA 10NET Communications, 7887 Washington Village Dr., #200, Dayton, OH 45459; (800) 358-1010, (513) 433-2238.
List Price: 8-bit ISA card, $425; MCA card, $475; 10BASE twisted-pair adapter, $249; 10BASE 10-megabit fiber-optic card, $795; 10NET Plus LAN bridge, $595; 10NET RS-232 connector, $295; concentrator, $2,200; transceiver, $195.
Requires: IBM PC, XT, AT, 386, 486, or PS/2 MCA compatible.
In Short: DCA 10NET offers an assorted product line for most of the LAN configurations on the market. The company's approach to 10BaseT doesn't include support for diskless workstations or an AUI connection, but its 10BASE line is part of a larger family of products, offering a wide variety of choices.

CIRCLE 412 ON READER SERVICE CARD

10BASET, COAXIAL, AND FIBER-OPTIC ETHERNET CABLING OPTIONS

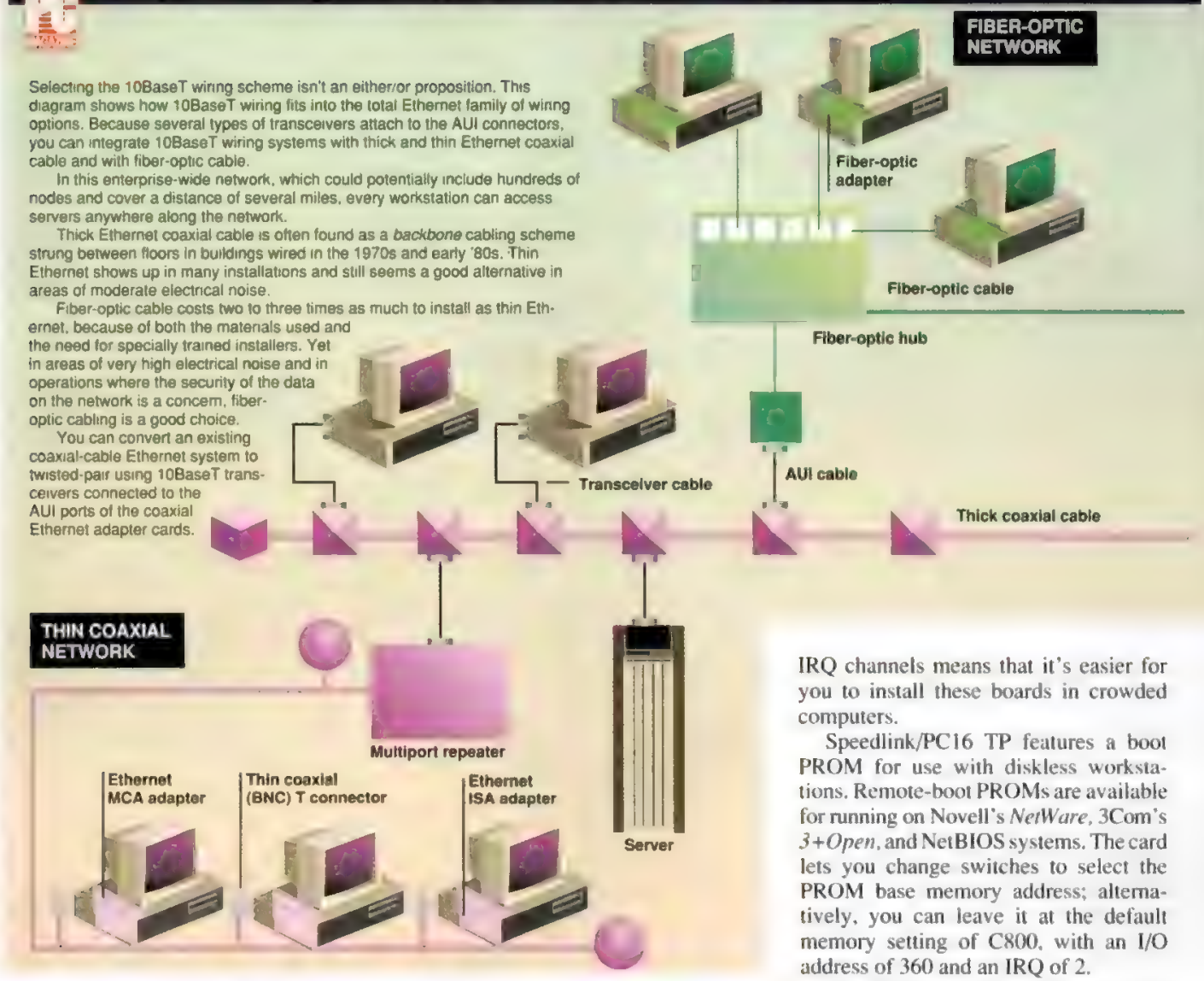
Selecting the 10BaseT wiring scheme isn't an either/or proposition. This diagram shows how 10BaseT wiring fits into the total Ethernet family of wiring options. Because several types of transceivers attach to the AUI connectors, you can integrate 10BaseT wiring systems with thick and thin Ethernet coaxial cable and with fiber-optic cable.

In this enterprise-wide network, which could potentially include hundreds of nodes and cover a distance of several miles, every workstation can access servers anywhere along the network.

Thick Ethernet coaxial cable is often found as a *backbone* cabling scheme strung between floors in buildings wired in the 1970s and early '80s. Thin Ethernet shows up in many installations and still seems a good alternative in areas of moderate electrical noise.

Fiber-optic cable costs two to three times as much to install as thin Ethernet, because of both the materials used and the need for specially trained installers. Yet in areas of very high electrical noise and in operations where the security of the data on the network is a concern, fiber-optic cabling is a good choice.

You can convert an existing coaxial-cable Ethernet system to twisted-pair using 10BaseT transceivers connected to the AUI ports of the coaxial Ethernet adapter cards.



EVEREX SYSTEMS INC.

Speedlink/ PC16 TP

by R. Dennis Boatner

With its first 10BaseT product, Speedlink/PC16 TP, Everex Systems has shown that it can offer innovation and a wide range of compatibility with existing LAN products at an outstanding price.

Everex sells both the $379 Speedlink/PC16 TP, a 16-bit card, and the $319 8-bit Speedlink/PC TP. Both of these adapters use SEEQ's 8005 chip along with a 64K packet buffer for reliable performance.

The Speedlink/PC16 TP card, like the SEEQ chip itself, uses surface-mount technology to help guarantee high-quality performance. The card contains two connectors, a DB-15 AUI connector for thin Ethernet and a twisted-pair connector for 10BaseT. One LED on the card monitors link status integrity, but there are no other diagnostic lights.

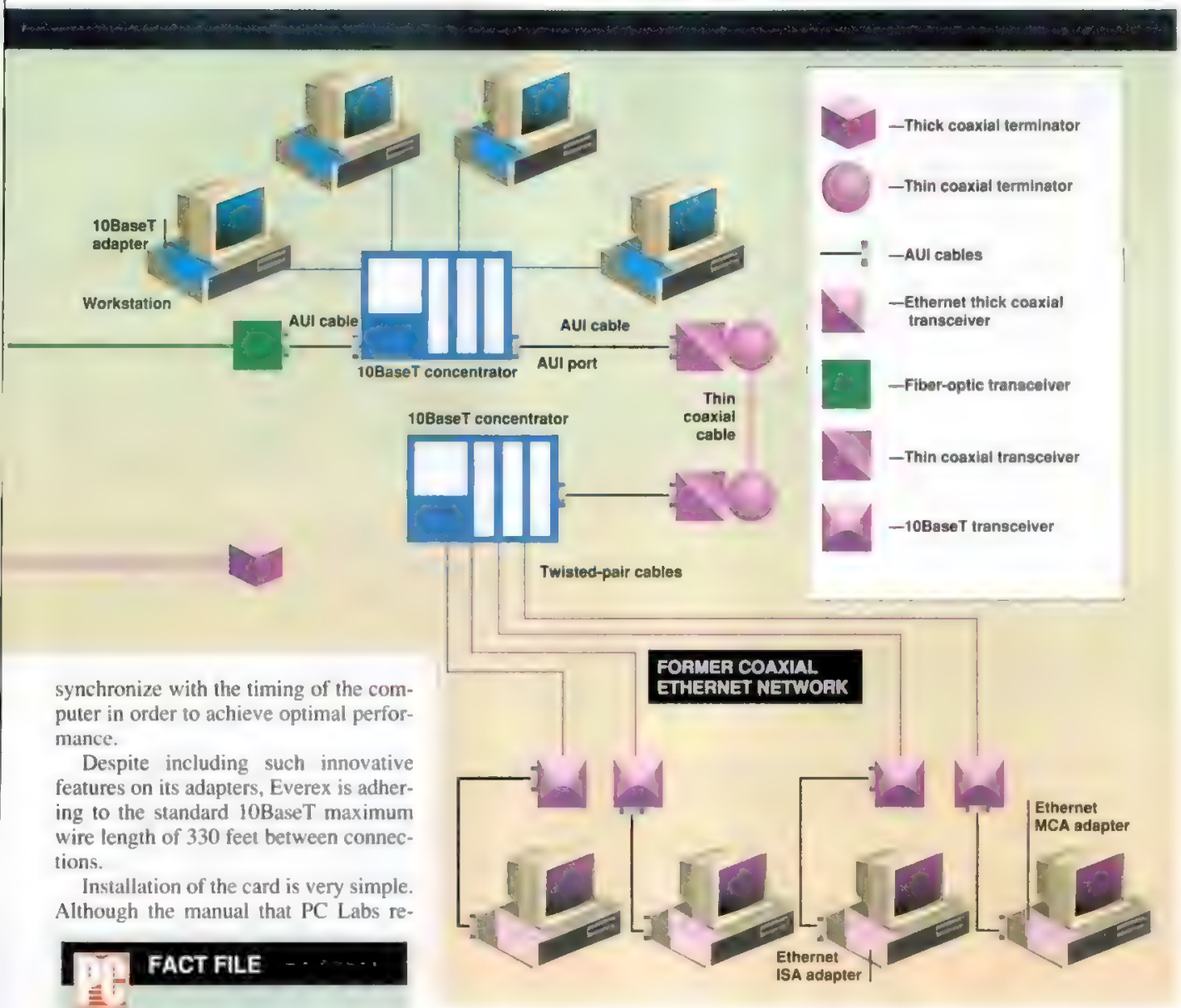
Speedlink/PC16 TP uses jumper-configurable settings to handle custom network setups. You can change the I/O base address from its default setting of 0360H with a DIP switch or select jumper settings for up to seven IRQ channels; most companies offer no more than five possible settings. The availability of many IRQ channels means that it's easier for you to install these boards in crowded computers.

Speedlink/PC16 TP features a boot PROM for use with diskless workstations. Remote-boot PROMs are available for running on Novell's *NetWare*, 3Com's *3+Open*, and NetBIOS systems. The card lets you change switches to select the PROM base memory address; alternatively, you can leave it at the default memory setting of C800, with an I/O address of 360 and an IRQ of 2.

The Speedlink/PC card also features an EMODE setting, which improves compatibility with the handful of machines whose IRQ-channel-ready signals don't meet original IBM specifications. Should your machine fall in this category, you can enable the jumper setting on the card to correct this problem.

GETTING STARTED

Installing the Speedlink/PC16 TP adapter in an 8-bit slot automatically disables the EMODE feature because critical timing doesn't affect this slot. But if you use the same card in a 16-bit bus and your system bus doesn't have the four wait states specified by IBM, then you can enable the switch to recognize the IRQ-channel-ready signal. This allows the board to



synchronize with the timing of the computer in order to achieve optimal performance.

Despite including such innovative features on its adapters, Everex is adhering to the standard 10BaseT maximum wire length of 330 feet between connections.

Installation of the card is very simple. Although the manual that PC Labs received was only a draft copy, it appeared to be both complete and concise. Everex says the finished document is shipping now. The software that accompanies the Speedlink/PC16 TP contains a set of diagnostics, a network test program, and a set of network drivers that includes drivers for Novell's *NetWare*, IBM *PC-NET/PC LAN*, *Network-OS*, *LANtastic*, *CommUnity-DOS*, PC-NFS, and various other NetBIOS-compatible network software packages.

Everex warrants the Speedlink products for one year against defects in workmanship and materials. The company also provides technical support free of charge (except for the long-distance call) for an unlimited period after purchase.

FACT FILE

Speedlink/PC16 TP
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (800) 821-0806.
List Price: Speedlink/PC TP, $319; Speedlink/PC16 TP, $379.
Requires: IBM PC, XT, AT, 386, 486 or compatible.
In Short: Everex uses some innovative concepts to increase performance and increase data-transfer reliability. A solid company with good support and quality products, this is a winner in the 10BaseT arena.

CIRCLE 413 ON READER SERVICE CARD

GATEWAY COMMUNICATIONS INC.

G/EtherTwist Adapters and Hub

by C. G. Milligan

One of Gateway Communications' primary lines of business is selling its value-added version of Novell's *NetWare*. Its 10BaseT products therefore focus on the *NetWare* environment. Although the company specializes in providing *NetWare* interfacing software for its LAN adapters, it also offers drivers that meet NDIS specifications; hence you can use

Gateway Communications's fully configured G/EtherTwist hub retails for $3,195 and accommodates up to 20 workstations.

its boards with Microsoft *LAN Manager* implementations as well as with Banyan *VINES*.

Gateway's G/EtherTwist products are strong contenders in the 10BaseT arena. The company sells 8- and 16-bit ISA bus 10BaseT adapters for $345 and $425 each, as well as a Micro Channel adapter for a relatively low $395. It also markets the $1,995 G/EtherTwist wiring hub. The standard wiring hub accommodates 11 connections, and you can expand the capacity to 20 connections in the same cabinet.

All of the boards include both RJ-45 and AUI ports and four LEDs that provide connection diagnostics. The cards use jumpers and switches for their configuration options; however, the manual goes into great detail regarding all aspects of installation. The wide variety of available configuration options ensures an address and interrupt combination that will easily coexist in even the most heavily loaded computer.

The interface cards use a National Semiconductor 8390 LAN controller chip, an 8391 Manchester Ethernet encoder/decoder, and an AT&T 7220 transceiver to accomplish the job. The 16-bit AT compatible card contains a 64K buffer. An optional boot PROM for diskless workstations allows access to a Novell *NetWare* LAN.

The card uses older through-hole construction techniques instead of the newer surface-mount technology. It was designed with certain components isolated from the ground plane for emission control.

GOOD CONNECTIONS

The wiring hub comes standard, with one chassis card providing 11 RJ-45 modular connections and a single AUI port, each with its own set of diagnostic LEDs. The 4- by 18- by 10-inch metal chassis accommodates one or two modular hub cards. A single 11-port hub card also comes standard, and a second hub card lists for $1,595. The fully configured 20-port concentrator hub is available from the company at a retail price of $3,195.

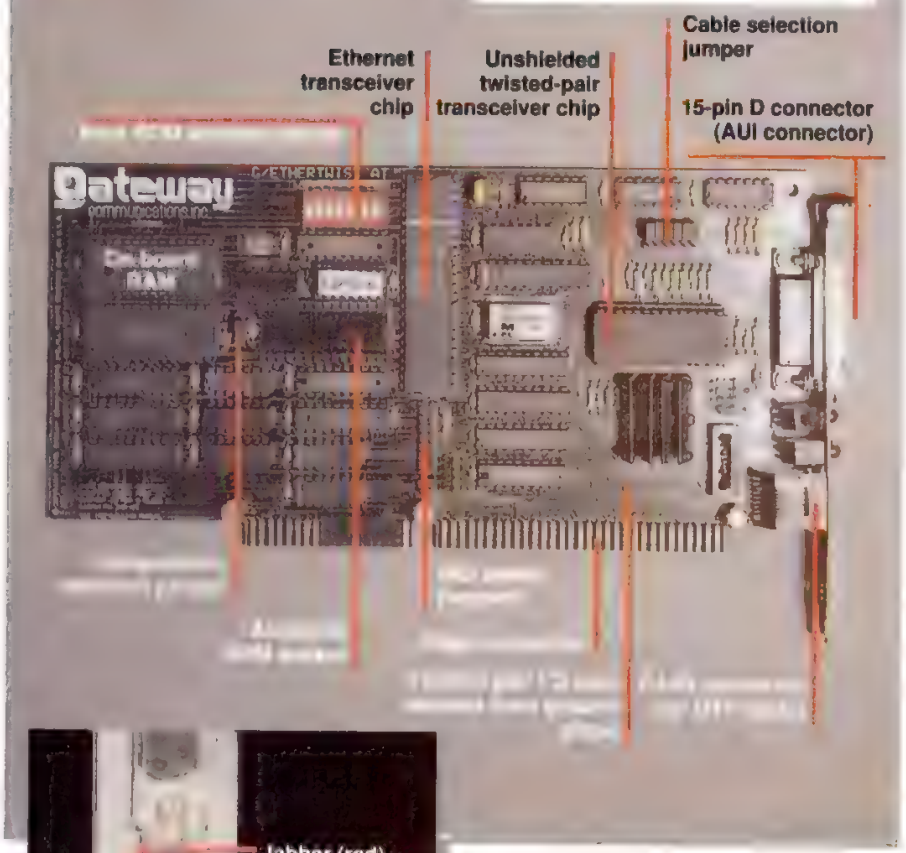
Adding a second hub card requires the installation of a crossover cable between an RJ-45 connector on each card, thus reducing the number of available connectors on each card to ten ports. Gateway's hubs are specially designed to reduce maintenance and network downtime by automatically disconnecting the faulty lines from the network. Once you resolve the problem, the hub automatically reinstates the line.

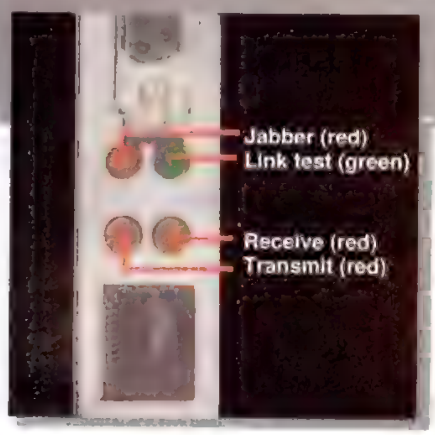
Gateway has a good reputation in the industry and acts as an OEM for such vendors as David Systems. Gateway also offers a one-year warranty and the advantage of free technical support hot line

THE 10BASET ADAPTER: A SUMMARY OF PARTS

The G/EtherTwist AT Adapter from Gateway Communications provides a good illustration of the parts of a 10BaseT adapter. The on-board RAM can hold certain protocols for fast execution. The compatability selection jumper allows you to use this type of adapter in PCs with bus timing different from that used in the IBM PC AT.

The boot ROM gives this board the ability to run in diskless workstations. The cable selection jumper determines whether the transceiver connects to the AUI connector or to the RJ-45 connector for unshielded twisted-pair wiring.





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With EMS	62K* *Minimum	Concurrent Send & Receive	Coax SDLC

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CIRCLE 296 ON READER SERVICE CARD

10BASET LAN ADAPTERS: SUMMARY OF FEATURES

Products listed in alphabetical order by company

This features table is organized by manufacturer; for more information on the products in each 10BaseT family, please consult the fact files. Also note that no EISA adapters are currently available for 10BaseT.

Some of the other features may require explanation.

AUI connector on card Having an Attachment Unit Interface (AUI) port on an adapter means that you can connect transceivers for fiber-optic or coaxial cable to the adapter if you need this type of attachment now or in the future. If your organization has several types of Ethernet wiring plans, this is an important option.

Link status LED It's useful to have a visual indication of the link integrity between the adapter and the wiring hub. Additional LEDs help LAN administrators quickly isolate problems.

NDIS network driver Adapters with NDIS drivers will work with Banyan's *VINES* and all versions of Microsoft's *LAN Manager* network operating system.

	AT&T Computer Systems **StarLAN 10 NAU**	Cabletron Systems Inc. **E2010 and E3010 Ethernet Cards**	David Systems Inc. **David Ether-T Adapters**	DCA 10NET Communications **10BASE Twisted-Pair Adapter**
PRICING				
8-bit ISA	$445	N/A	$350	$425
16-bit ISA	N/A	$495	$445	N/A
MCA	$445	$649	$475	$475
FEATURES				
AUI connector on card	◻	■	■	◻
Remote-boot PROM	❑	❑	■	❑
Link status LED	❑	■	■	■
Net activity LED	❑	■	■	❑
Transmit LED	❑	■	■	■
DRIVERS				
NetWare 286 driver	■	■	■	■
NetWare 386 driver	■	■	■	◻
NetBIOS network driver	❑	■	❑	■
NDIS network driver	■	■	■	■

◻—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: no such model is available.

services to its customers. Its implementation of 10BaseT provides the ability to install adapters in crowded machines easily and to create networks with reliable wiring systems.

FACT FILE
EDITOR'S CHOICE

G/EtherTwist Adapter
G/EtherTwist Hub
Gateway Communications Inc., 2941 Alton Ave., Irvine, CA 92714; (800) 367-6555, (714) 553-1555.
List Price: G/EtherTwist PC adapter, $345; AT adapter, $425; MCA adapter, $395. First 11-port G/EtherTwist hub, $1,995; second 11-port hub card, $1,595; concentrator, $3,195. Novell *NetWare* boot ROM, $35.
Requires: IBM PC, AT, ISA, or MCA compatible.
In Short: Gateway markets a 16-bit 10BaseT adapter and a wiring hub expandable from 11 to 20 ports. An OEM supplier for vendors such as David Systems, the company is a Novell value-added reseller, so its boards work with every version of *NetWare*. An NDIS driver gives the adapter *LAN Manager* and Banyan *VINES* capabilities, too.

CIRCLE 414 ON READER SERVICE CARD

HEWLETT-PACKARD CO.

HP Ethertwist PC Link

by R. Dennis Boatner

Hewlett-Packard devotees will feel right at home with HP's latest venture into the 10BaseT arena. The quality of the HP Ethertwist PC Link card is up to HP's normal high standards, and the company offers a full complement of 10BaseT products. However, if you are looking for a low-cost way to handle LAN expansions or replacements, other companies probably offer better solutions.

While the Hewlett-Packard 10BaseT product is only a year old, the company has offered twisted-pair LAN products since 1985. The HP Ethertwist PC Link card departs from the other boards we reviewed in that it uses the smaller RJ-11 wire connector, found commonly in most new buildings, instead of the RJ-45 other vendors use. The price of this card is $445, with a Micro Channel version, the HP Ethertwist Micro Channel Link, priced at $595. Considering the features, this is high-end pricing.

The HP Ethertwist PC Link card uses an 8-bit ISA or MCA bus, along with surface-mount technology. It has no AUI or RJ-45 connector and no LED indicator lights. Also, there is no diskless workstation boot PROM, so if your organization uses such a setup, you should shop elsewhere. The I/O base address is selectable via a switch bank setting, with the IRQ set automatically by the software. HP has also isolated a portion of the board from the ground plane to reduce emissions.

FACT FILE

HP Ethertwist PC Link
Hewlett-Packard Co., Roseville Networks Div., 8000 Foothills Blvd., Roseville, CA 95678-6598; (800) 752-0900.
List Price: HP Ethertwist PC Link, $445; HP Ethertwist Micro Channel Link, $595; HP Ethertwist Hub, $1,899; HP Ethertwist Hub Plus, $2,299; modular adapter, $99; Ethertwist transceiver, $159; *Open View* hub manager, $1,499; Wire Test Kit, $149.
Requires: IBM PC, XT, AT, 386, 486 or PS/2 MCA compatible.
In Short: HP's 10BaseT product line has high prices and high quality. The boards don't provide diagnostic LEDs, but the hub has an extensive diagnostic and management system.

CIRCLE 415 ON READER SERVICE CARD

Everex Systems Inc. Speedlink/PC16 TP	Gateway Communications Inc. G/EtherTwist	Hewlett-Packard Co. HP Ethertwist PC Link	IMC Networks Corp. PCnic TP Family Card	NetWorth Inc. EtherNext LAN 10BaseT System	Standard Microsystems Corp. SMC/3016TP	3Com Corp. Etherlink II/TP	Western Digital Corp. EtherCard Plus10T
$319	$370	$445	$275 (workstation)	$395	$395	$345	$349
$379	$445	N/A	$375 (workstation)	$495	$395	$895 (Etherlink Plus)	N/A
N/A	$460	$595	$375 (workstation)	$595	N/A	$495	$399
■	■	□	□	■	■	■	■
■	■	□	■	■	■	■	■
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■	□	□	□	□	■	■	■
■	■	■	□	■	■	■	■

Currently Hewlett-Packard supports only Novell's *NetWare* 2.15 and the HP *LAN Manager* (based on Microsoft's *OS/2 LAN Manager* and *3+Open*) software drivers. HP maintains the IEEE 10BaseT standards for connectivity at 330 feet.

Installation is simple, and the manual contains good documentation on how to set up the hardware. The card is warranted for one year, and technical support is also available through the dealer network.

HP also makes an Ethertwist Hub Plus, priced at $2,299, that handles up to 12 connections on each hub. You can stack these hubs and link them via a daisy-chain connection. A $99 modular adapter breaks the signals from 50-pin twisted-pair port to 12 8-pin modular jack connections to 4-pair twisted-pair LAN cables. HP also makes an Ethertwist transceiver that has an AUI connection to a twisted-pair RJ-11 connector and is priced at $159.

HP has an *Open View* HUB Manager that requires *Microsoft Windows 286* software and 2MB expanded memory; it sells for $1,499. This product allows the LAN administrator to monitor all the hubs on the network. The software uses color changes and icons to identify any problems. Additionally, HP sells a Wire Test Kit to do loop-back testing on your wire for $149.

HP has a long-standing reputation for

THE PUNCH-DOWN BLOCK: A Closetful of Trouble

by Frank J. Derfler, Jr.

Telephone system suppliers such as AT&T, Northern Telecom, the regional Bell operating companies, and other PBX companies have standards for telephone wiring systems. Their standards, and the resultant wiring systems, are not identical, but they are close enough that you can usually assume their wiring systems can carry your data—if there are enough vacant wire pairs in the cables.

The heart of all the systems is the same: a wiring closet with rows of *punch-down blocks*. Some companies call them *Telco Splice Blocks*, and veterans know them from the old AT&T monopoly days as *Type 66 Blocks*. Whatever their name, these central wiring points often become central failure points in wiring plants.

A punch-down block gets its name from the act of using a special hand tool to punch a wire down between the jaws of a retaining clip. The clip slices through the polyvinyl chloride (PVC) insulation on the wire and makes electrical contact. Punch-down blocks make installations and changes simple while avoiding the major problem of telephone systems: short circuits.

However, the quality of the electrical connection made by the punch-down process varies considerably. Moisture, crystallization, electrolysis, and corrosion all can degrade the electrical connection. On a voice system, the bad connection results in lower volume and perhaps frying or popping sounds. The human ear and brain deal with those problems admirably. Unfortunately, computer systems have less than human flexibility.

AT&T and other companies have new wire splice blocks. AT&T's block—called *Type 100*—uses wire-wrap techniques and gold contacts to make better connections. If you experience transmission problems using unshielded twisted-pair wire—and re-punching or wiggling wires on the existing splice block changes the condition—you should consider retiring the old punch-down block in favor of more modern, albeit higher priced, wire-connection alternatives. ■

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CIRCLE 135 ON READER SERVICE CARD

making quality products and providing worldwide service. Although the 10BaseT adapters don't have the best price/feature ratio, the total hub management system is excellent. As a vendor, HP provides a good comfort level for managers looking for quality.

BENCHMARK TESTS: 10BASET LAN ADAPTERS

We found little difference in performance among the 10BaseT products. Apart from Cabletron's E2010 and E3010 Ethernet Cards, all the adapters were compatible with other network hardware, and the maximum difference in wiring-hub throughput was less than 2 percent. Overall, 10BaseT should perform on a par with thin Ethernet networks.

The **Network Throughput Under Load** test loads network cards, media, and access protocols but places a small load on the server. While the timed station transfers files, load stations read and write 1-byte data files, creating a high volume of data packets and increased activity on the network.

HOW WE TESTED

The PC LAN Labs benchmark tests are written in C and are independent of commercial software. Each load station operates at a rate many times that of a PC in a typical heavy-use environment (such as a data-entry operation).

We ran all the tests using the same server, workstations, and cabling. The server was a Dell Model 325, a 25-MHz 80386-based system, with 8MB RAM. It ran Novell's *NetWare 386*, Version 3.0. The workstations were Dell System 200s running at 12 MHz (with an 8.33-MHz data bus speed), and we used Gateway Communications' G/EtherTwist as the hub.

The **Network Throughput Under Load** benchmark test reports the throughput recorded during the performance of a standardized task on the network. To obtain the figures shown here, we run a test program performing a sequential create, a sequential read, a sequential write, a random read, and a random write of a large file. The record sizes used in these activities systematically rotate among 16K, 4K, and 512 bytes.

While the general test program is run, we load the network with a specific program for the Network Throughput Under Load test. We report each product's throughput in kilobits per second, based on repeated runs of the test using files of 1MB and larger.

IMC NETWORKS CORP.

PCnic TP Family Card

by R. Dennis Boatner

When a company is willing to back its product for five years, you can be certain that that product is worth examining. Such is the case with IMC Networks, a company that entered the 10BaseT product market in 1988. A relative newcomer to the 10BaseT arena, IMC Networks has managed to put together an impressive product line that offers low price, an unbeatable warranty, and plenty of free technical support.

IMC's ISA cards come in 8-bit and 16-bit configurations. There is a 16-bit card with 64K of RAM, designed for both file server and busy workstation use, that sells for $350. A 16K card, for use as a workstation card only, sells for $325. The PCnic 8-bit card is available only in a 8K workstation version and retails for $275.

IMC also has an MCA bus line with the same configuration. The 64K file-server version sells for $375, and the 16K workstation version sells for $350.

The IMC cards use surface-mount technology and include one LED indicator light to monitor link integrity. The cards come with an RJ-45 connector, but, unfortunately, no AUI connection, so the boards work on 10BaseT only. If you use Ethernet cards, you'll have to use a separate Ethernet hub, which the company also provides.

PCnic provides a boot PROM for diskless workstations, but only for Novell's *NetWare*. The I/O base address and the boot PROM address are set in a switch bank located next to the boot PROM. The IRQ address is set through the software installation program.

IMC is holding to the 10BaseT standard of 330 feet between connections. These software interfaces support Novell's *NetWare*, *NetWare 386-ODI*, and PC-PIP/FTP/TCP.

IMC calls its 10BaseT wiring hub the PCnic Basket. This modular repeater, supporting ten connections and one AUI port, sells for $1,295. This unique hub is in a cabinet similar to those used for low-profile PCs. It accepts expansion boards in a way similar to a PC. You can even mix and match 10BaseT, fiber, and coaxial cable connection cards in the same cabinet. An Ethernet version with the same configuration is also available and sells for $1,935.

The PCnic Basket is conveniently designed with diagnostic and activity lights on both the front and back panels. Overall, this is a uniquely modular and flexible wiring hub. Because all the wires and cables come out of the back, you can set the hub in the open where someone can monitor the lights without exposing everyone to a Medusa head of unsightly wires.

Warranty on these products is unbeatable: a hefty five years on parts and workmanship. IMC also provides unlimited free technical support.

IMC is an innovative company with sharp-looking products. Even if you want adapter cards with the flexibility of an AUI port, you should still consider its PCnic Basket wiring hub for its flexibility and good looks.

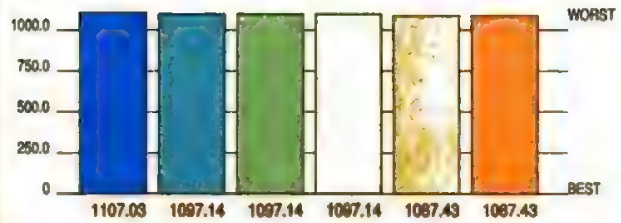
FACT FILE

PCnic TP Family Card
IMC Networks Corp., 342 Bell Ave., Unit 3E, Tustin, CA 92680; (800) 624-1070, (714) 259-1020.
List Price: 16-bit cards: 16K ISA, $325; 64K ISA, $350; 16K MCA card (workstation version), $350; 64K MCA card (file server version), $375. 8-bit card: 8K only, $275. Twisted-pair PCnic Basket wiring hub, $1,295; coaxial, $1,395.
Requires: IBM PC, XT, AT, 386, 486, or compatible.
In Short: IMC has a good 10BaseT product line, but the adapters don't have an AUI connection for other transceivers. The company, however, offers an exceptional five-year warranty.

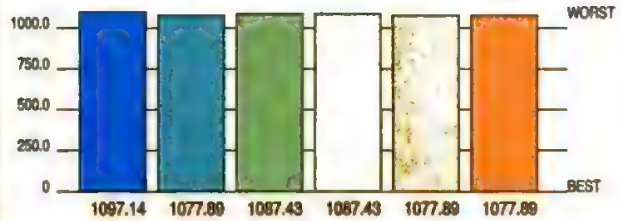
CIRCLE 416 ON READER SERVICE CARD

16-BIT ADAPTERS

Zero Stations — Throughput*



One Station — Throughput*



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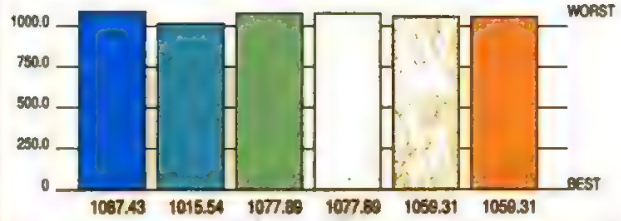
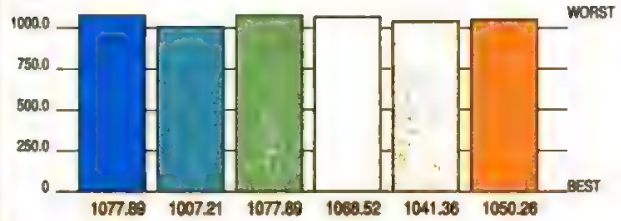
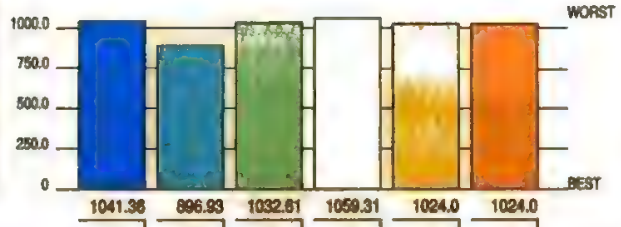


Three Stations — Throughput*



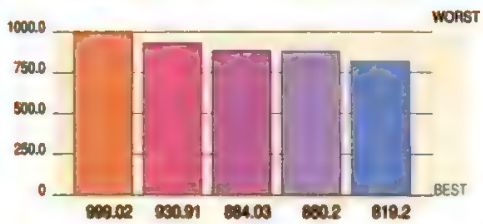
Four Stations — Throughput*



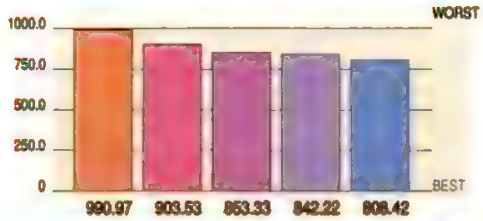
EtherNext LAN 10BaseT System
Speedlink/PC16 TP
SMC/3016TP
†Ethernet (thin coaxial cable)
G/EtherTwist
PCnic TP Family Card

8-BIT ADAPTERS

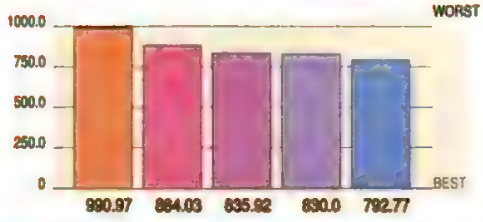
Zero Stations — Throughput*



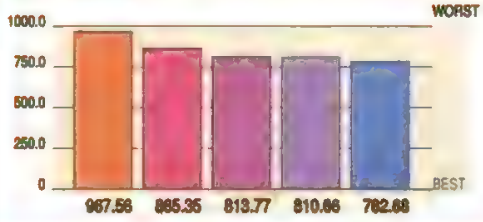
One Station — Throughput*



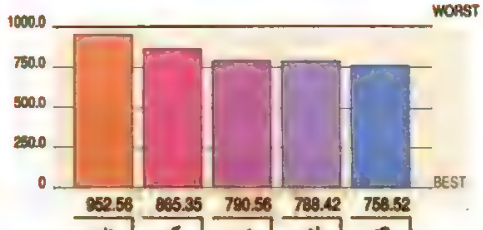
Two Stations — Throughput*



Three Stations — Throughput*



Four Stations — Throughput*



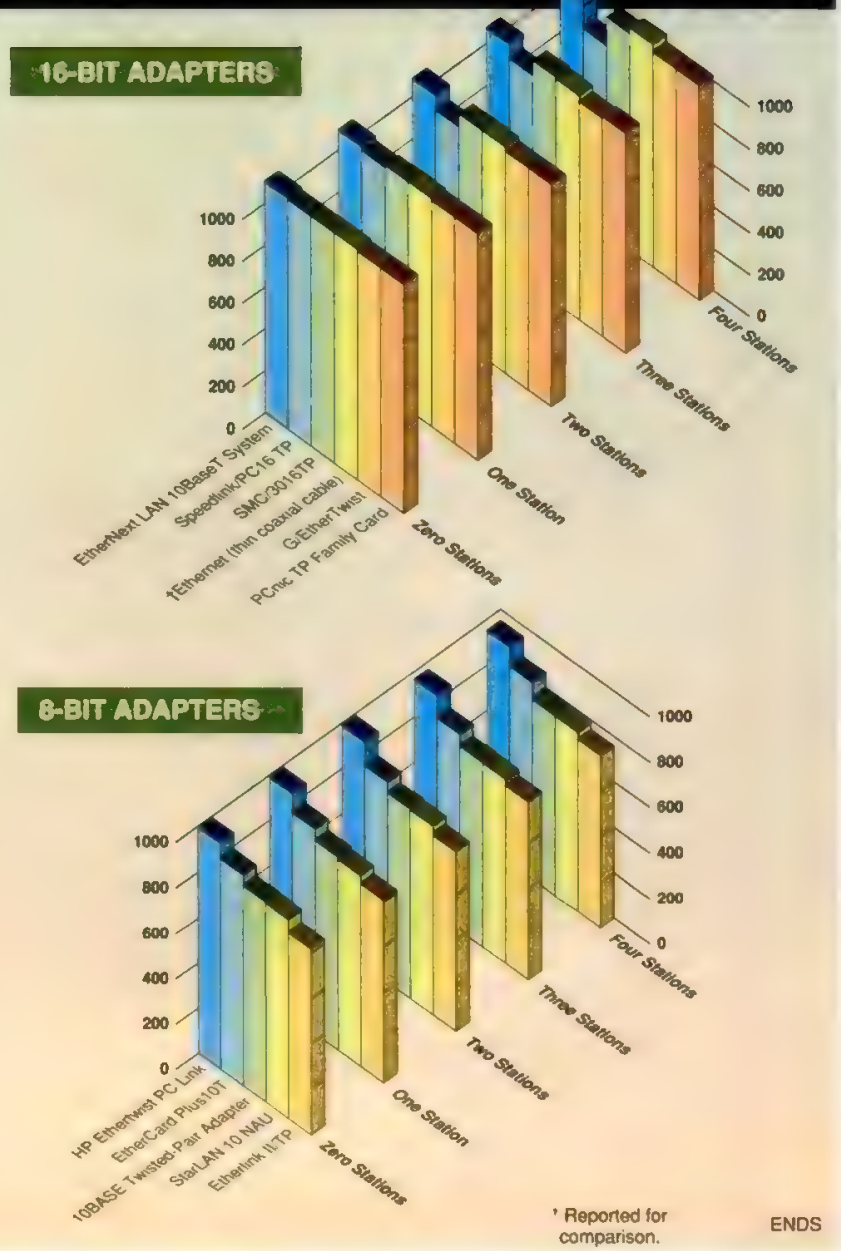
HP EtherTwist PC Link
EtherCard Plus10T
10BASE Twisted-Pair Adapter
StarLAN 10 NAU
Etherlink II/TP

* Kilobits per second.
† Reported for comparison.

CONTINUES

NETWORK THROUGHPUT UNDER LOAD: COMPOSITE VIEW

(Taller bars represent better performance)



We found little difference in performance among the 10BaseT products we reviewed. These results are graphic proof that Novell has made it easy for 10BaseT card manufacturers to write good drivers for *NetWare 386*. By adhering to 10BaseT standards, virtually all manufacturers have made their adapters compatible with other network equipment.

In only one case—Cabletron Systems' E2010 and E3010 Ethernet Cards—did we find compatibility problems. No results for these cards are shown here because incompatibilities between the adapters and PCs prevented us from completing our tests. The company could not deliver working cards in time for our review.

The hubs were completely compatible, and the difference in throughput was less than 2 percent between fastest and slowest (although the specific hub results are not reported here). Furthermore, we found no significant difference between 10BaseT and an Ethernet network using thin coaxial cable. For comparison, we tested such a network using Novell's NE2000 adapter in the server and Gateway's 16-bit G/Ethernet AT adapters in the workstations.

The reported scores represent one workstation's throughput while up to four other stations supply contention on the network. To capture some sense of the overall network performance, we tried monitoring the LAN with Network General Corp.'s Sniffer. Throughout the test, the Sniffer's network throughput monitor remained pegged out at over 3,000 packets per second and could measure no further. A post-test analysis showed that the server actually moved an average of 4,700 packets per second during the testing. The packets averaged a very small 112 bytes, so the adapters and hubs on the network were kept very busy. For each group of products, the total number of packets that the server moved correlated perfectly with the measured throughput we are reporting here.

Note that DCA 10NET Communications was not able to deliver *NetWare 386* driver software in time for our test, so we used an NE1000 adapter instead of an NE2000 in the server. Also, because David Systems markets the same network adapters sold by Gateway Communications (G/EtherTwist), we are not listing separate results for David Systems' cards.

NETWORTH INC.

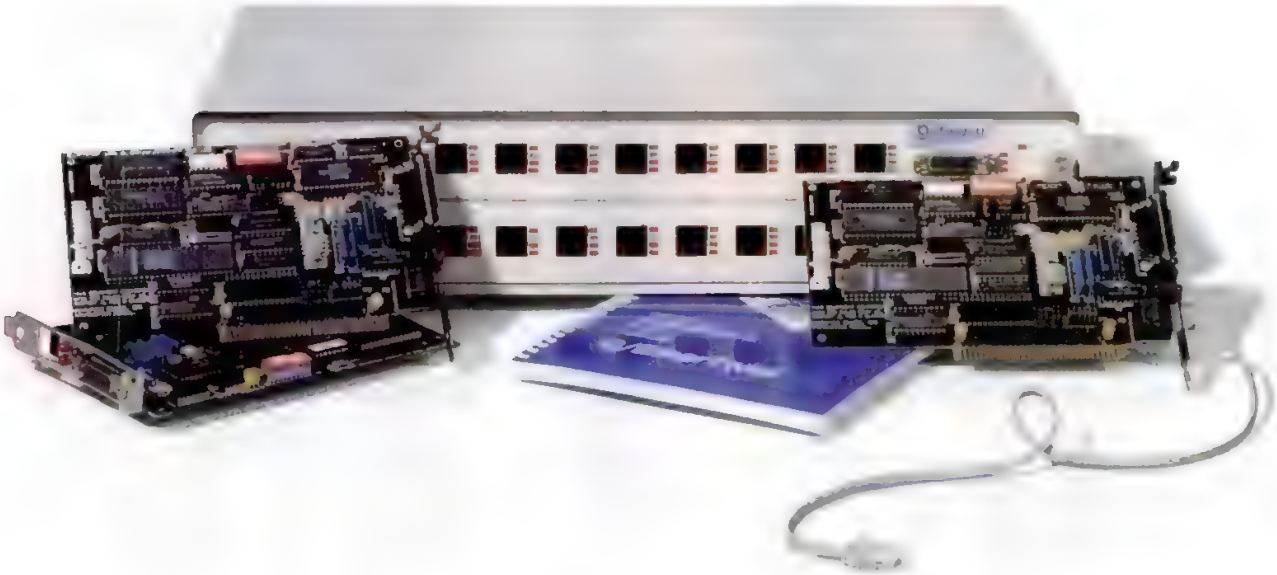
EtherNext

by Frank J. Derfler, Jr.

NetWorth has anxiously waited to stamp its own Texas brand on the 10BaseT standard. It has marketed two twisted-pair LAN products for several years, but success was limited by the lack of standards in this market. Now NetWorth has dug its spurs in for a big drive into 10BaseT.

NetWorth will sell you 8-bit and 16-bit ISA bus adapters, a 32-bit MCA adapter, a MAC II adapter, and a 10-port wiring hub. The ISA adapters sell for $395 and $495; the MCA is $595, and hub prices start at $1,995. The adapters come with drivers for the *LAN Manager* NDIS interface and *NetWare*. The 8-bit ISA adapter emulates a Novell NE-1000, and the 16-bit adapter emulates the Novell NE-2000. If you already use these Novell Ethernet adapters, you needn't worry about keeping track of two types of *NetWare* shells. NE-1000 and NE-2000 compatibility also

G/Ethernet with a new twist...



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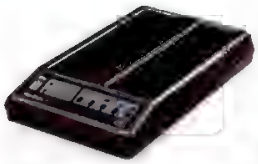
CIRCLE 146 ON READER SERVICE CARD

PUT YOUR TRANSMISSION INTO

OVERDRIVE

9600etc/e



If you're a little old lady from Pasadena, you can probably pass on this baby. But if you're into high speed transmission and superior performance (at a price that's easy to handle), you're going to want to shift into the ATI 9600etc/*e* Modem.

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In a clutch or anytime, the 9600etc/*e* can perform at mind-boggling speeds. By combining the industry standard V.32 protocol with V.42*bis* data compression, the 9600etc/*e* can simultaneously transmit and receive data at over 38,400 bps...four times faster than other 9600 bps modems. Imagine the savings on transmission costs.

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Check out the dash. ATI's Easy-Set Front Panel gives you convenient access to frequently used commands. Whether you drive a PC or a mainframe, the 9600etc/*e* provides 100% error-free data transfer. Completely compatible with the Hayes* 'AT' command set, the 9600etc/*e* also supports MNP protocols and slower modems operating at 2400, 1200 and 300 bps.

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CIRCLE 337 ON READER SERVICE CARD

means that many third-party drivers for TCP/IP and other protocols will work on these adapters.

Because the NetWorth boards emulate the *NetWare* adapters, you can use the driver software written and maintained by Novell. The NetWorth adapters outperformed all of the other products by a slim margin. We attribute this more to the tried and tested quality of the drivers than to any other factor.

FACT FILE

EtherNext LAN 10BaseT System
NetWorth Inc., 8101 Ridgepoint Dr., #107, Irving, TX 75063; (800) 544-5255, (214) 869-1331.
List Price: 8-bit ISA card, $395; 16-bit ISA card, $495; UTPPS2 MCA card, $595. 10-port hub with link integrity LEDs, $1,995; with collision elimination, $2,195. BNC-compatible hub with link integrity LEDs, $2,195; with collision elimination, $2,395.
Requires: IBM PC, XT, AT, 386, 486, or PS/2 MCA compatible.
In Short: NetWorth markets a full line of adapters and several types of wiring hubs. Its products include a collision avoidance scheme that reduces Ethernet conflicts in very heavily loaded networks.

CIRCLE 417 ON READER SERVICE CARD

The adapters have both RJ-45 and AUI connectors, but they sport only one LED in contrast to the two or four diagnostic lights flickering on other cards. The single light tests for continuity of the link to the hub: if the link breaks, the light turns off. You might not get as much information as you would with systems that have polarity and data-traffic indicators, but you will know there's a problem.

You can use slide jumpers to choose one of four IRQ and four address alternatives. This is in keeping with the design of the NE1000 and NE2000 adapters. The ISA adapters use slide jumpers to set the IRQ and address locations.

Collision elimination (CE) is a special technique developed by NetWorth, with a patent application pending, to improve the throughput of Ethernet-type adapters in very heavily loaded networks. The typical 10BaseT wiring hub is a repeater that sends all incoming signals out to all points. NetWorth's wiring hub has circuitry that watches the packets come in; as a packet enters the hub, a special signal tells other cards to stop transmission. Since this technique saves the first packet from the damage and subsequent delay usually associated with the collision detection inherent in the standard CSMA/CD technique, it reduces the need for retransmission.

According to the company, CE doesn't improve throughput in lightly loaded networks, but it has the potential for significantly improving throughput in heavily loaded networks. PC LAN Labs, however, could not substantiate NetWorth's claims. We loaded a network to a sustained speed of more than 3,000 Ethernet frames per second and saw consistently slower throughput when we ran in the CE mode. Overall we like the NetWorth hardware a lot. But we don't see any advantage to using the nonstandard CE mode when the industry standard CD mode works so well.

You can buy a variety of wiring hubs from NetWorth. The simplest $1,995 hub has ten ports and an AUI connector. A $2,195 version of the same hub implements the CE feature. Other hubs with added thin-Ethernet connectors are available. The hubs are in good-looking gray cabinets and are easy to mount in a wiring closet or a relay rack. None of the NetWorth hubs include management features aside from monitoring lights.

NetWorth aggressively markets and supports its products. The company offers a one-year warranty and toll-free support on all of its products. The compatibility of NetWorth's products with Novell's adapters is a big plus.

STANDARD MICROSYSTEMS CORP.

SMC/3016TP

by R. Dennis Boatner and C. G. Milligan

Standard Microsystems Corp., a pioneer in ARCNet cards since 1983, has developed an impressive Ethernet adapter, the SMC/3016TP, that conforms to the current 10BaseT network standards. Available since May, the $395 SMC/3016TP is a 16-bit, three-quarter-length card that is compatible with an 8- or 16-bit bus configuration.

The SMC/3016TP uses a surface-mount LSI chip—the Fujitsu EtherStar—a MB86950 LAN controller chip that ensures compatibility with the high-speed bus of a fast 386 or 486 system. The user selects a jumper on the card to integrate it into an 8- or 16-bit bus. A chip socket for a boot PROM is provided for diskless workstation integration. The card also has an RJ-45 and AUI connector located on the rear of the unit, making it compatible with several wiring schemes and most transceivers. This card has three diagnostic LEDs showing link status, transmissions, and network activity.

The current software driver suite consists of Novell's *NetWare 286/386*, NetBIOS, PC-Net, Banyan's *VINES*, and NDIS. The board design uses surface-mount technology on an ISA bus. You control IRQ settings with jumpers on the board.

FACT FILE

SMC/3016TP
Standard Microsystems Corp., 35 Marcus Blvd., Hauppauge, NY 11788; (516) 273-3100, (516) 273-7935.
List Price: $395; eight-port Ethernet concentrator/repeater, model SMC-3508TP, $1,195.
Requires: IBM PC, AT, 286, 386, or compatible.
In Short: SMC is a highly reputable company that has been in business since the beginning of PCs in network environments. The 16-bit, 3/4-length SMC/3016TP represents a true value from a company that offers good technical support.

CIRCLE 418 ON READER SERVICE CARD

As is the case with many cards, the Ethernet 3106TP shows an area of isolation from the ground plane to help meet FCC Class B standards.

The company has remote-boot PROMs available for Novell's *NetWare*. SMC offers a two-year warranty and has both unlimited technical support and a toll-free 800 number to handle any problems that arise.

SMC also reports that it is shipping an Ethernet concentrator/repeater, model SMC-3508TP, with eight ports; it is priced at $1,195. The product was not available at review time, however.

3COM CORP.

Etherlink II/TP

by R. Dennis Boatner

3Com Corp. did pioneering work in 1982 at the beginning of the 10BaseT development cycle and has since sold more than 1 million adapters. With this record, it's no surprise that the company offers a wide assortment of 10BaseT cards and accessories and has even solved the problem of reception at distances greater than the established 100-meter limit. This system offers LAN users a reliable, cost-effective means of solving complex LAN setups.

3Com offers a variety of adapters. The $445 3Com Etherlink II/TP card uses both 8- and 16-bit ISA bus interfaces. The Etherlink MC/TP provides a 16-bit MCA interface for the IBM PS/2 Models 50 through 80. This card is competitively priced at $495. The boards use jumpers to set the I/O and memory addresses. Each comes equipped with two diagnostic LEDs to indicate link and activity status and furnishes both AUI and RJ-45 connections.

DRIVER SUPPORT

Compatibility is a definite strong point when it comes to software that runs on the Etherlink II/TP. The twisted-pair adapter uses the same drivers designed for the popular 3Com EtherLink II adapter. The list of supported drivers starts with the 3Com *3+* network operating system for DOS, MS-OS/2 *Lan Manager*, PCS/XNS and PCS/TCP, DECNet DOS and PCSA, Sun PC-NFS and *TOPS*, Novell's *Advanced NetWare*, *NetWare 386*, and Banyan's *VINES*, just to list a few.

3Com's engineers isolated part of the board from the ground plane to reduce emission and take a step toward FCC Class B approval. The Etherlink II/TP uses surface-mount technology and contains space for a 16K PROM with four possible memory addresses. You can select DMA channels 1 through 3 and IRQs 2 through 5.

The remote-boot PROM is currently available only for 3Com and *3+Open* operating systems. (*3+Open* is 3Com's OEM version of Microsoft's *LAN Manager* software.) An 8K RAM buffer for multiple Ethernet packets, along with the number of transmit and receive buffers, is software configurable. You set the IRQs for the card with software that comes with the board.

The Etherlink II/TP adapter works with a high-performance transceiver that delivers a signal as far as 410 feet over twisted-pair wiring without becoming susceptible to electrical interference. This distance is substantially farther than the 330-foot maximum established as the 10BaseT standard. The designers accomplished this by installing a more sensitive receiver circuit in the transceiver of the board that allows connections to be extended from 100 to 125 meters. 3Com developed an application-specific integrated circuit (ASIC) that increases data transfer, reliability, and power efficiency.

3Com's MultiConnect Multiport Repeater, with its 15 ports, can support up to 1,024 connections via the company's MultiConnect TP module card. The concentrator sells for $1,295 and has an overall size of 5.5 by 17 by 19.5 inches (HWD). 3Com's module card plugs into the concentrator and passes the information from the bus to the 10BaseT system via the AUI, BNC, or fiber-optic connectors. This card supports up to 45 direct connections of twisted-pair wiring in a single chassis and is priced at $595.

The Etherlink II/TP includes a three-year warranty on defects in material and workmanship. 3Com has been farsighted enough to install a resettable polymer fuse that can handle direct shorts and thereby reduce service requirements. This, coupled with a high degree of reliability based on the company's estimated mean time between failure (EMTB) of over 70 years, makes Etherlink II/TP an excellent investment. Any additional support you may need can be handled by the resellers.

Many network managers rely on 3Com's 3C503 Ethernet adapters. The twisted-pair version should continue to be a leading product in the market.

FACT FILE

Etherlink II/TP
3Com Corp., 3165 Kifer Rd., Santa Clara, CA 95052-8145; (800)-NET-3COM.
List Price: Etherlink II/TP, $445; Etherlink MC/TP, $495; Etherlink Plus, $895.
Requires: IBM PC, XT, AT, PS/2 Model 25 or 30 compatibles.
In Short: 3Com is a leader in 10BaseT. Compatibility with the popular 3C503 drivers is a big plus. Ease of installation along with increased transmission distances makes this a real value.

CIRCLE 419 ON READER SERVICE CARD

WESTERN DIGITAL CORP.

EtherCard Plus10T

by C. G. Milligan

Western Digital has two offerings for the 10BaseT 10-megabit-per-second Ethernet market. Considering their quality and versatility, these adapters are inexpensive. For systems with an ISA-compatible bus, the $349 EtherCard Plus10T is a half-length, 8-bit card that is at home in systems from compact PC XTs to full-blown 486 EISA speed demons. For IBM Micro Channel–compat-ible systems, the $399, full-length EtherCard Plus10T/A will solve your connectivity needs.

For people putting together networks in a multivendor environment, the best part about the Western Digital package isn't the adapter but rather the *SuperDisk* that comes in every box. This diskette contains a variety of driver software and patches that let you use the adapters in the *NetWare*, *LAN Manager*, NetBIOS, or Digital Equipment Corp. network operating systems. (Software is also available for the TCP/IP system, though you'll pay extra for it.) Even if you can't settle on one operating system, you can settle on one hardware system from a major vendor.

COMPATIBILITY

Western Digital does not make hubs, but the company assures compatibility with a variety of 10BaseT concentrators, including those from Cabletron, David, Multi-Tech Systems, NetWorth, Plexcom, and Synoptics Communications. Drivers are available for virtually any network software system on the market.

These cards use 8-pin, modular RJ-45 phone jacks for connection to either 10BaseT concentrator hubs, or AT&T and Hewlett-Packard StarLAN 10 hubs. Although the original StarLAN 10 hubs don't have the link integrity test feature, a jumper disables the Western Digital card's corresponding feature. This allows greater compatibility with an existing StarLAN 10 system. Disabling this option also dis-

The day they
make a
laptop computer
that meets all
your needs, you'll
read about it
in a magazine.

ables the 15-pin AUI port. In standard configuration, there is no required jumper selection for using either connector.

If you appreciate the looks of nice hardware, you'll appreciate the WD adapters. These small boards use surface-mounting techniques for the components, and the layout and construction shout quality. Certain components are clearly isolated from the ground plane to reduce electronic emission.

Each card comes equipped with four status LEDs. The Link Status LED indicates link integrity. A Polarity Correct LED senses improper cable polarity and internally attempts to correct the problem. There are also LEDs for transmit and receive. The diagnostic software supplied with these cards will help localize any problems that may happen to arise. Configuration of the Western Digital Plus Series LAN cards is a simple procedure, accomplished by a setup program—a great help in determining a suitable port address and interrupt for the cards.

Western Digital combines its own WD83C691A Ethernet Encoder/Decoder chip with a surface-mounted National Semiconductor DP8390 LAN controller chip to ensure compatibility with Ethernet standards. The Plus10T card has an 8K RAM buffer, while the Plus10T/A has a 16K dual-port RAM buffer that allows for increased throughput.

A boot PROM for diskless workstations is also available for $39. It comes in *NetWare* and 3Com *3+* flavors and in 16K, 32K, and 64K sizes. The mappable memory requirement is from 8K to 80K maximum for the largest PROM size and RAM buffers.

Western Digital has an excellent reputation for quality; it offers an outstanding assortment of drivers for different LAN environments. These folks might be the only true friends you have when you try to navigate a multivendor LAN jungle. ■

FACT FILE
EDITOR'S CHOICE

EtherCard Plus10T
Western Digital Corp., 8105 Irvine Center Dr., Irvine, CA 92718; (800) NET-LEAD, (714) 757-3950 (tech support), (714) 932-5000.
List Price: ISA-compatible EtherCard Plus10T, $349; MCA-compatible EtherCard Plus10T/A, $399. Optional diskless workstation boot ROM, $39.
Requires: EtherCard Plus10T: IBM PC, XT, AT, 386, 486, or compatibles and non-Micro Channel PS/2 systems. EtherCard Plus10T/A: IBM Micro Channel PS/2s and compatible systems. 10BaseT concentrator hub, StarLAN 10 hub, or a Media Access Unit (MAU).
In Short: Western Digital offers ISA bus and Micro Channel adapters for 10BaseT. Hardware configuration is accomplished through a software setup program, and the company has drivers for virtually any LAN operating system on the market.

CIRCLE 420 ON READER SERVICE CARD

R. Dennis Boatner *is a computer consultant working in Florida.* **Frank J. Derfler, Jr.,** *is workgroup systems editor of* PC Magazine. **C.G. Milligan** *is a frequent contributor to* PC Magazine.

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CIRCLE 483 ON READER SERVICE CARD

Here it is in a magazine.

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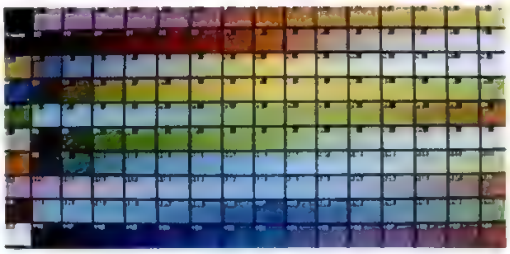
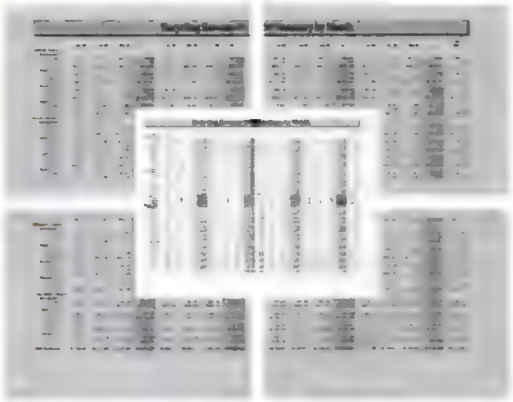
NEC

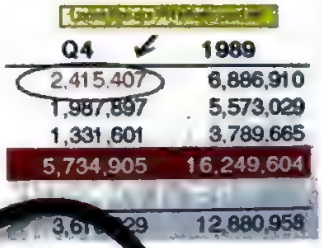
CIRCLE 335 ON READER SERVICE CARD

A palette of 224 dazzling colors – more than any other spreadsheet – to make your graphics as powerful as your words.





Only Release 3.1 offers an auto-compress feature that quickly reduces larger worksheets so they print on a single page.



Q4	1989
2,415,407	6,886,910
1,987,897	5,573,029
1,331,601	3,789,665
5,734,905	16,249,604
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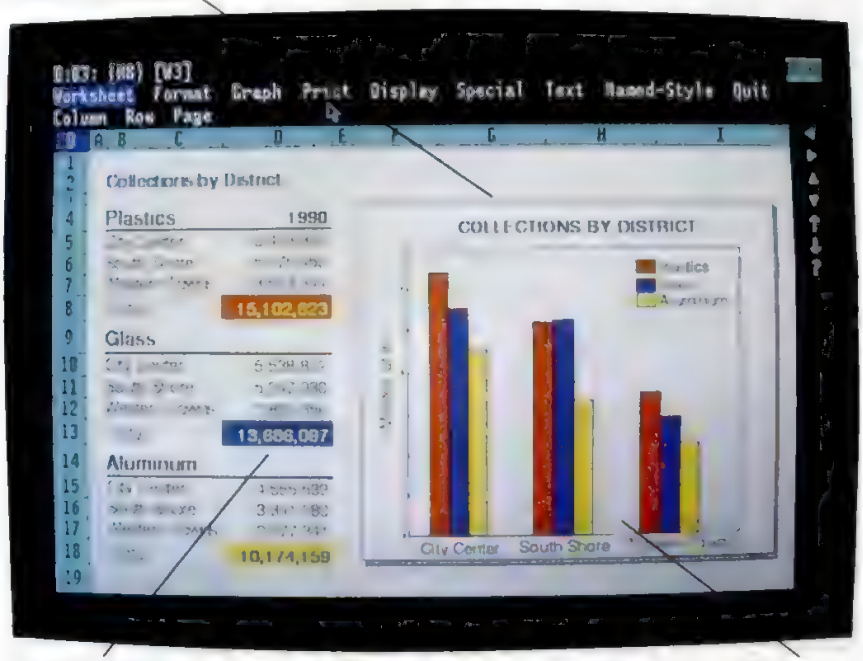

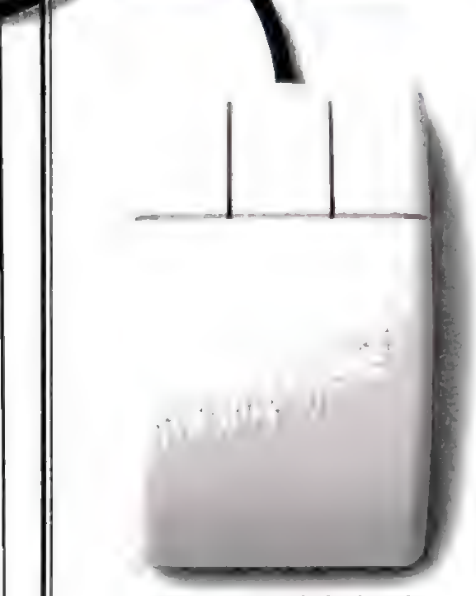

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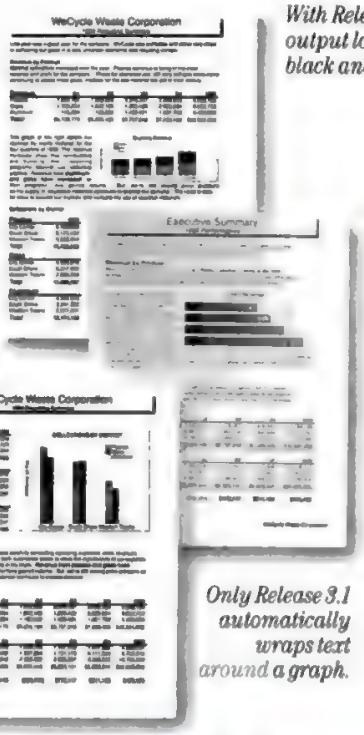

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Revenue by Product

Material collections increased over the year. Plastics continue to bring in the most revenue and profit for the company. Prices for aluminum are still very soft and while we're continuing to collect more glass, markets for the raw material are still in their infancy.

Revenue	Q1	Q2	Q3	Q4	1990
Plastics	1,890 785	1,982,024	2,378,397	2,836 983	9,088,189
Glass	1,700,504	1,862,135	1,869,430	2,600,684	8,032,753
Aluminum	1,146,884	1,182,022	1,489,421	1,601,763	5,420,090
Total	$4,738,173	$5,026,180	$5,737,248	$7,039,430	$22,541,032

Only Release 3.1 automatically wraps text around a graph.

The graph at the right details our revenue by waste material for the four quarters of 1990. The revenue increases show that communities are building their recycling programs beyond just collecting plastics. Revenue from **aluminum and glass have increased** as their programs have gained volume. But, we're still seeing price pressure as the supply of recyclable materials continues to exceed the demand. We need to look for ways to expand our markets and increase the use of recycled materials.

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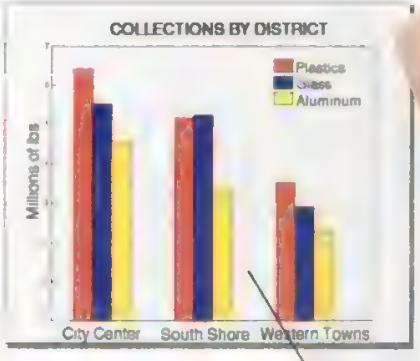
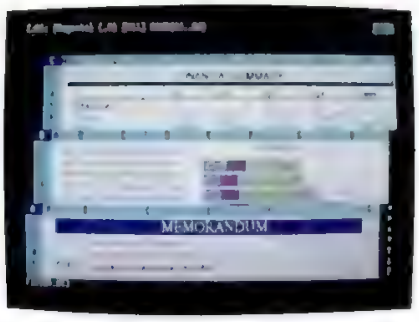
Collections by District

Plastics	1990
City Center	8,403,829
South Shore	5,175,450
Western Towns	3,523,344
Total	15,102,623

Glass	
City Center	5,536,812
South Shore	5,247,930
Western Towns	2,899,356
Total	13,684,098

Aluminum	
City Center	4,555,539
South Shore	3,341,280
Western Towns	2,277,341
Total	10,174,159





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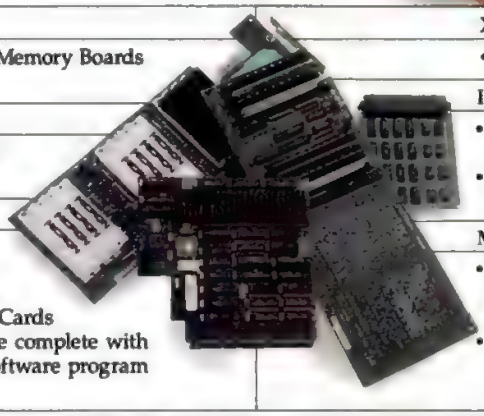

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by
Roger C. Alford

Lab Notes

PC Scanners: Not Just for High-end Users Anymore

With annual sales increasing at a rate of 200 to 250 percent, optical scanners have become a hot item in the PC market. Their ability to read and convert images into a form the PC can manipulate has already proved their value, particularly in desktop publishing, database management, and computer-aided design (CAD) applications. Increasing capabilities and falling prices are sure to widen their popularity still further.

Even today, with simple hand-held units available for under $100, scanner technology is accessible to the most dollar-conscious computer user. This Lab Notes will give you an overview of the kinds of considerations you should bear in mind when trying to match your needs to what's available and upcoming, and the sidebar glossary will guide you through the jargon of this rapidly developing field.

The need to incorporate diagrams, logos, photographs, and other graphics has made desktop publishing the predominant application for scanners. Scanned images range from two-tone line art to continuous-tone photographs, which the scanner can convert to as many as 256 gray-scale levels. Graphics software packages then complete the job by cropping, rotating, and otherwise editing the scanned illustrations to produce the best possible appearance in the final document.

Scanned images are not restricted to artwork, however. When coupled with optical character recognition (OCR) software, scanners can bring printed text and numbers into the PC, converting the images into text or spreadsheet files that can be processed by standard database, word processing or spreadsheet programs. While PC-based OCR is still relatively new, the necessary OCR software is already sophisticated enough for widespread use, and information-demanding applications will probably provide one of the largest growth areas for scanner use in the years immediately ahead. (Watch for our round-up of OCR software packages in the next issue).

■ Both in handling graphics images and in OCR, today's scanners offer performance you can't afford to ignore.

At present, computer-aided design is a relatively small but increasing market for scanner use. Scanners allow line art to be incorporated into CAD drawings, but an impediment to their wider use has been the difficulty of converting the raster scanned images into vector CAD images. New software packages will likely simplify or eliminate this problem within the next year or so.

TYPES OF SCANNERS

There are two primary types of scanner: hand-held and page (desktop) units. Hand-held scanners have a scan width of between 2 and 5 inches, so they often require you to make multiple manual sweeps to read in an entire document. Software is then used to merge the multiple sweeps into a single, uniform document. The merging process can be difficult, however, and some software packages do it better than others. Although hand-held models are sometimes used for OCR applications, the inevitable wobble imparted by the human hand makes it difficult to achieve the near-perfect scan required by OCR. Hand-held scanners are better suited for applications involving small figures that can be scanned in a single pass.

Page scanners can handle a full page at a time. These units are further divided into three categories: sheet-fed, flatbed, and overhead. From a user standpoint, sheet-fed scanners are similar in operation to typical office fax machines. The page to be scanned is simply fed in and rollers pull it through the machine. (Sheet-fed scanners are also sometimes called roller-feed scanners.) The rollers are the only moving parts in the unit; the scan optics and circuitry remain motionless as the pages flow by. Functionally simpler (and thus generally less expensive) than most flatbed scanners, sheet-fed scanners have the important disadvantage of being unable to handle pages from books, pamphlets, and other bound or stapled materials.

Flatbed scanners are mechanically the most complex—and usually the most expensive—type of scanner. You operate them rather as you do a standard office copier. The document to be scanned is placed facedown on a glass plate. Below the glass, an optical head assembly moves along the document to scan the image. This design can easily handle books and other bound materials. Note that many flatbed and sheet-fed scanners also support an optional automatic page feeder, which may be a highly valuable feature in such applications as OCR or PC fax.

Overhead scanners look very much like overhead projectors. In these units, documents are placed on a flat surface and are scanned from a head that's positioned above it. The acceptable size of the scanning surface varies among scanner models, but since these scanners are designed with a moderately wide field of view, most can also scan three-dimensional objects

that are placed on the target surface.

Note that because their scanning consistency is controlled from within and is not subject to the unpredictable variations introduced by manual movement, page scanners of any of the three types are preferred over hand-held models for OCR applications.

SCANNER RESOLUTION AND SCALES

A scanner's *resolution* is the number of dots it can sample for each linear inch of the document. Common resolutions are 75, 100, 150, 200, 300, and 400 dots per inch (dpi). But because most of today's laser printers are themselves limited to 300 dpi, this resolution is the highest that most scanners provide. And yet paralleling the trend toward higher-density laser printer output, a few 400-dpi scanners *have* been introduced.

Higher scan resolutions result in larger disk files for scanned images, since more bits of information are stored for the image. Many scanners now offer user-selectable scan resolution, typically allowing the user to select any standard resolution up to the limit of the scanner. This allows smaller files to be created for simpler images scanned at a lower resolution, while retaining support for higher resolution when needed.

The simplest scanners are *bilevel* devices. Also called *two-tone* scanners, these units are primarily used for simple drawings and other line art that can be represented in simple black and white. Attempting to scan photographs and other continuous-tone or halftone illustrations with a two-tone scanner results in the loss of most of the detail.

Significant numbers of gray-scale scanners came on the market in 1987, making it practical to scan photographs. Nearly all gray-scale scanners fall into one of three categories: 16-level, 64-level, and 256-level. These are also known, respectively, as 4-bit, 6-bit, and 8-bit scanners, corresponding to the number of bits required to store each gray-scale pixel (picture element) of information. (Just for completeness, there is at least one 128-level, 7-bit scanner available.)

Ordinary "black-and-white" photographs are actually *continuous-tone* images. That is, they contain a virtually unlimited number of shades between black and white. Gray-scale scanners divide the range between pure black and white into 16, 64, or 256 discrete shades of gray. Obviously, the more shades supported by the scanner, the more accurate the digitized image representation can be, but since this also means storing more bits per pixel, it also results in larger image files on the disk. Naturally, too, scanner cost is proportional to the number of gray levels supported.

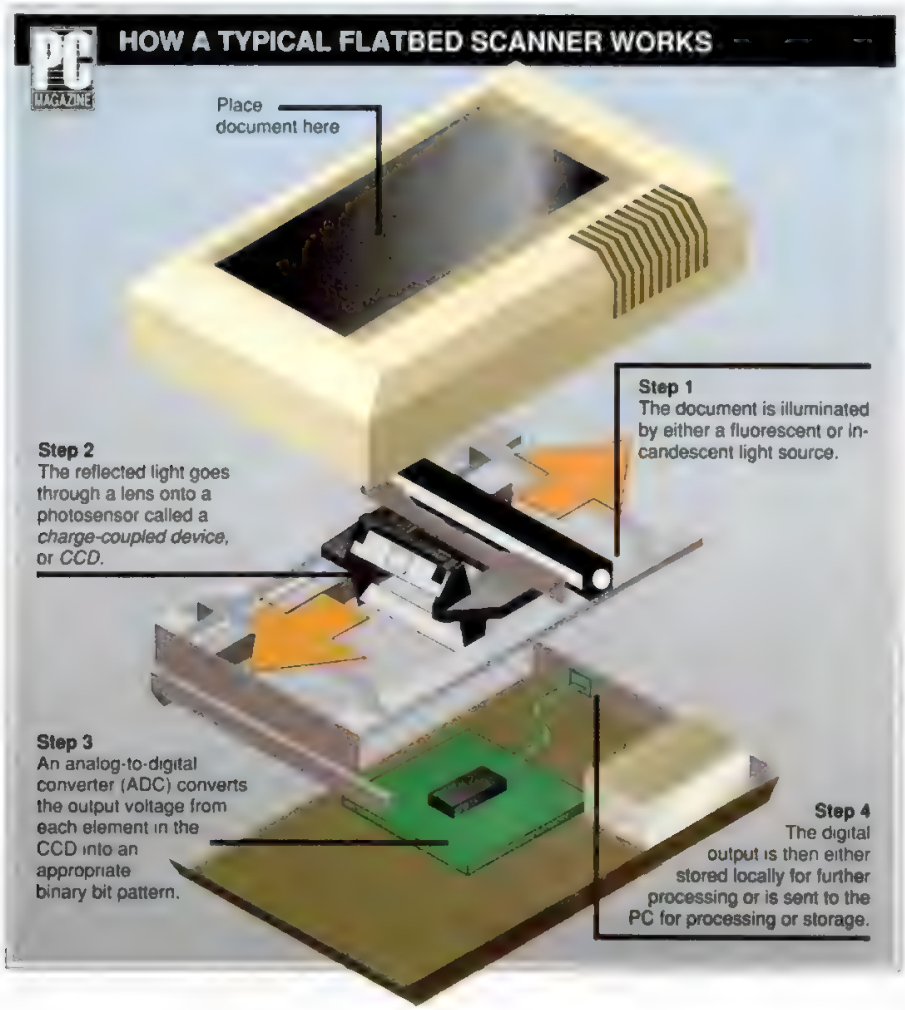

Figure 1: When coupled with OCR software, scanners can bring text, images, and numbers into a PC for use in various applications. Scanners are used primarily for desktop publishing.

HOW SCANNERS WORK

The operation of a typical scanner is illustrated in Figure 1. The document is illuminated by either a fluorescent or incandescent light source. The reflected light goes through a lens onto a photosensor called a *charge-coupled device*, or *CCD*. The CCD is a linear array of photoelectric elements or light detectors, typically from 2,000 to 4,000 in number. Each element outputs a voltage proportional to the amount of light falling on it. A black spot on the document absorbs most of the light, allowing very little to reflect to the CCD; this results in a low voltage output. A white spot reflects most of the light, resulting in a high voltage output. Gray levels (or colors) between these extremes similarly cause proportional voltages to be generated by the CCD elements.

The analog output voltages from the CCD elements must then be converted into digital values. In a simple two-tone scanner a threshold voltage (usually adjustable) about halfway between the black-and-white voltages is chosen as the decision point. Voltages below the threshold are considered black (0), and those above the threshold are white (1). Such a scanner thus uses 1 bit per pixel. In a gray-scale scanner, an analog-to-digital converter (ADC) converts the output voltage from each element in the CCD into an appropriate binary bit pattern that represents the in-

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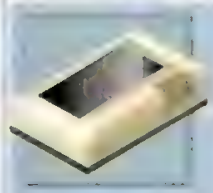

SCAN THE TERMS

by Roger C. Alford

Bilevel scanner A scanner that outputs only black-and-white pixels, based on a specific threshold level. Scanned pixels darker than the threshold are considered black, while those lighter than the threshold are considered white. No gray pixels are supported. This is also called a black-and-white scanner.

Brightness A measure of the overall amount of white in an image. A pure white image has the maximum brightness, while a pure black image has the minimum brightness.

CCD (charge-coupled device) An integrated circuit device containing as many as 4,000 light-sensitive elements packed closely together in a single row. When combined with the necessary optics, this device gives the scanner the ability to "see" the document being scanned.

Character scanner A scanner with internal OCR software either stored in firmware in the scanner or downloaded from the PC. The scanner decodes scanned text and outputs the ASCII character values for the decoded characters. A character scanner is generally designed only for OCR and is not normally used for graphics applications. Also called a text scanner.

Continuous-tone image An image that has a nearly infinite number of gray levels (shades) between black and white, such as a photograph.

Contrast The range of gray tones in an image. High contrast shows clear definiation between light and dark objects. Low contrast tends to show many more midrange gray tones, with almost a smearing effect. A contrast change alters all of the gray tones of an image.

Data transfer rate The rate at which scanned data is transferred from the scanner to the PC. This is generally measured in bits-per-second (bps).

Desktop scanner A scanner designed to rest on the top of a desk or other flat surface. There are three main types of desktop scanners: flatbed, sheet-fed, and overhead. A hand-held scanner is not a desktop scanner.

Dithering A method of using variable dot densities (with black dots) to simulate various shades of gray. The more dense the dots, the darker the apparent shade of gray.

Feature extraction An approach to optical character recognition (OCR) that involves looking for a combination of distinguishing features that can uniquely identify each standard character or symbol. For example, the software might list the features of the letter *b* as a vertical line with a connecting semicircle on the lower-right portion. When the characteristics of a character being decoded match those that are stored in a table in memory, the ASCII code for that character is sent to the output file. Feature extraction is more flexible than the matrix matching alternative, since it is completely independent of the font being decoded. Feature extraction is also called *feature recognition*, *pattern recognition*, or *topological analysis*. (See also *matrix matching* and *optical character recognition*.)

File formats The formats used to store scanned graphics images on-disk. TIFF is the most common scanner (graphics) file format, with .PCX, .IMG, .EPS, and .PIC being other commonly supported formats.

Flatbed scanner A scanner that has a flat top upon which the document to be scanned is placed facedown, in much the same way as in a conventional photocopier. Flatbed scanners typically offer the best scan results of any scanner type and also cost the most.

Gamma correction An approach for changing the brightness (shade) of a particular gray level (or a range of levels) wherever it appears in a graphic image. This might entail, for example, changing all 25-percent grays in an image to 60-percent grays. Gamma correction is particularly useful in brightening shadows or other isolated areas of an image.

GPIB (General-Purpose Interface Bus) A popular parallel interface bus used to interconnect electronic devices. It is capable of transferring 8 bits at a time and is sometimes used to connect scanners to PCs. It is also known as the IEEE-488 bus, and the HPIB (Hewlett-Packard Interface Bus). GPIB is a standard of the Institute of Electrical and Electronics Engineers (IEEE) and the American National Standards Institute (ANSI).

Gray-scale scanner A scanner capable of determining a gray-level numeric value for each pixel scanned. The numeric range for each pixel is determined by the number of bits handled by the scanner. A 4-bit scanner can differentiate 16 shades of gray between black and white, inclusive; a 6-bit scanner can differentiate 64 shades of gray. A black-and-white scanner is just like a gray-scale scanner, but with only one bit representing two shades.

Gray scale Refers to viewing an image as composed of varying shades of gray between black and white rather than comprising only the two tones of black and white. A gray-scale scanner sees each pixel (or dot) of an image as one of many possible shades of gray (typically 16, 64, or 256). Bi-level scanners see each pixel as either black

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tensity of the reflected light within the number of bits per pixel supported by the scanner. An ADC with 4-bit resolution will output binary values between 0000 (black) and 1111 (white); similarly, a 6-bit ADC will output binary values between 000000 (black) and 111111 (white), and so on. With either type of scanner, once the analog voltages are converted into digital values, the resulting information is either stored locally for further processing or is sent to the PC for processing or storage.

Each reading of all the CCD elements represents a full-width, single pixel-row scan. Since such a scan is only one pixel-row deep, successive pixel rows are then scanned until the entire document or image has been read. The CCD may be advanced to the next pixel row by one of several methods: by manually moving the scanner (hand-held scanner), by automatically moving the scanner head (flatbed scanner), by automatically advancing the page across the scanner head (sheet-fed scanner), or by automatically moving a reflecting mirror (overhead scanner).

Color scanners work similarly to gray-scale scanners except that they must also extract color information from the document. This is normally accomplished by using multiple scans with colored lights and filters. New scanners to be introduced in the next year or so claim single-pass full-color scanning.

Some scanners preprocess the scan image data locally before sending anything to the PC. This is frequently done in the case of OCR applications, where the character-recognition software is either stored in the scanner's firmware or else is downloaded from the PC to the scanner during the initialization process. With its resident OCR software, the scanner can then convert the image file to text and send ASCII characters to the PC.

Most scanners, however, do not preprocess the image data. The unprocessed digital image data is simply transferred to the computer, where it is typically stored in a disk file. Indeed, simple scanners do not even store the binary image data locally before sending it on, but simply transfer the data as it is converted to digital format. Once the scanner image data is in the PC, the PC can process the image information as required, using OCR software, graphics-editing software, or other utilities.

SCANNER IMAGE FILE STORAGE

What your PC does with the image data it receives is partly determined by the utility software included with the scanner. Some scanner utilities are very flexible and allow the data to be stored in any of a number of popular file formats. Others are restricted to one or two formats—which is fine if these are the formats your applications use. Moreover, if you find yourself needing a format not supported by your scanner, all is not necessarily lost: a number of graphics-editing programs can convert between different graphics file formats. Most notable is *HiJaak*, from Inset Systems, which is capable of translating between any of 26 different file formats.

The file format supported by most scanners is the tagged-image file format, or TIFF. TIFF was developed by Aldus Corp. (the creator of *PageMaker*), with the help of Microsoft. The latest version (5.0) of the TIFF specification supports gray-scale and color images in addition to black-and-white images.

Another file format supported by most scanners is .PCX, which is used by ZSoft's popular paint program, *PC Paintbrush*. Other file formats supported by a number of scanner software packages include .EPS (Adobe Systems' Encapsulated PostScript), .IMG (from Digital Research's *GEM* software), .PIC (from Media Cybernetics' *Dr. Halo*), .PFF (used by Epson printers), and .FAX (Group III facsimile). Proprietary formats are also used by some scanner manufacturers, such as Computer-Aided Technology's .CAT file format.

> If you need a file format not supported by your scanner, turn to graphics-editing programs, one of which can translate between 26 different formats.

Whatever the file format, when working with scanners, you'll need *lots* of memory. While the standard 640K of system RAM will generally suffice for the scanning process itself, 2MB or more of RAM (and a 286 or 386 processor) are often required to manipulate or edit the scanned images, particularly those that involve multiple gray-scale levels. Some of the desktop publishing software packages, such as Xerox's *Ventura Publisher*, also require additional memory in order to incorporate large scanned images.

Scanning an 8½ by 11-inch document at 300 dpi with a simple two-tone scanner results in a 1MB disk file. Adding gray scale or color quickly multiplies this size. An 8-bit gray-scale image makes an 8MB disk file, and a 24-bit RGB color image (8 bits per color) takes a whopping 24MB of disk space! As you can see, storing a few images on your disk can quickly eat your disk away.

SCANNER INTERFACES

There is no single standard interface for connecting scanners to PCs. Rather, three interfaces are prevalent: RS-232 (serial), the Small Computer System Interface (SCSI), and the General-Purpose Interface Bus (GPIB). The common RS-232 serial interface is generally relegated to low-end scanners, which are in no hurry to get information back to the PC. While an inexpensive and easily accessible interface, the serial port's slow data transfer rate is generally irritating at best and completely unacceptable in many cases.

SCSI (pronounced "scuzzy") is the most commonly used interface for desktop scanners. A parallel interface capable of transferring 8 bits at a time, SCSI is finding increasing application for high-end disk drives, too, and is standard equipment on the Apple Macintosh. SCSI is an ANSI-standard interface and normally connects between the PC and the scanner through a 50-conductor cable.

GPIB, another parallel interface that transfers 8-bit words, is heavily used in electronics instrumentation, but is also well suited as a PC-to-scanner interface. Also known as the IEEE-488 bus (a standard of the Institute of Electrical and Electronics Engineers and an ANSI standard), this interface uses a cable with 24-pin connectors that look rather like shrunken Centronics printer connectors.

Some scanners connect directly to the PC's parallel (printer) port. This offers an easy, inexpensive connection to the PC and is faster than the RS-232 serial port in-

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terface, but it's slower than either the SCSI or GPIB alternatives. Other, nonstandard interfaces are sometimes used. Hand-held scanners, for example, commonly use a proprietary interface to achieve an acceptable data transfer rate at minimal cost.

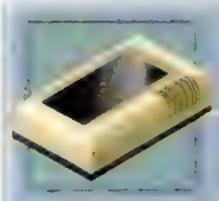
INSTALLING A SCANNER

Installing a scanner is generally a straightforward procedure, though inevitably there are "gotchas" to avoid. Most scanners include an interface card, so be sure your computer has a free expansion slot. Further, the interface cards often require an interrupt line and/or DMA channel for proper operation; as long as not all of your interrupt lines and DMA channels are used by other installed boards, all should be well. Of course, the few scanners that use the computer's own serial or parallel port do not require an expansion slot, only the presence of the specified port.

Whether a scanner includes an interface board or simply connects to the system's serial or parallel port, the unit is almost always supplied with an appropriate interface cable. Since it is generally desirable to keep the scanner physically close to the computer, most of these cables tend to be rather short (6 to 10 feet). In many cases, the cable length is also a restriction of the interface being used as well. If you find it necessary or desirable to move the scanner further away from your PC than the included cable allows, contact the scanner manufacturer; he may have other cable lengths available. Scanners that connect to the PC's serial port can easily be placed 50 or more feet away from the PC without incurring interface-related problems.

Following the instructions included with the scanner package, configure the interface card as necessary (in most cases the default settings will work) and install it in an available expansion slot. Most interface cards are half-height XT size, so any slot will work. After the scanner is placed on the desk or cart that will be its new home, simply connect the supplied interface cable to both the scanner and the interface card or PC port. (Many hand-held scanners have a preconnected cable coming out of the scanner, like a mouse, and so require only a connection to the interface board.)

Power for hand-held scanners is supplied through the interface cable; desktop units are supplied with a standard AC pow-



SCAN THE TERMS

CONTINUED

or white regardless of its true shade of gray. (See also *bi-level* or *gray-scale scanner*.)

Halftone A stored or printed image that simulates its continuous-tone original (typically a photograph) by using a dithering process. (See also *continuous-tone image* and *dithering*.)

Hand-held scanner A scanner held in the hand and manually swept across the document or image being scanned. Hand-held scanners may be either bi-level or gray-scale scanners.

Image scanner A scanner used to scan images, as opposed to scanning and decoding text.

Line art Drawings and other black-and-white-only images having no gray tones.

Matrix matching An approach to optical character recognition (OCR) in which scanned characters are compared to specific, previously stored character shapes. When the pixels of the scanned character match (are in the same place as) the stored character, the ASCII value for that character is sent to the output file. Only previously stored (previously "learned") fonts can be decoded using this approach. Matrix matching is also called font recognition. (See also *feature extraction* and *optical character recognition*.)

Omnifont A term that refers to the feature-extraction approach to optical character recognition (OCR), since feature extraction can universally decode a wide range of character fonts and typestyles. (See also *feature extraction* and *optical character recognition*.)

Optical character recognition (OCR) The process of decoding characters (text) from scanned documents. The decoded characters are then stored in a disk file in standard ASCII text format, allowing other programs, such as word processors, database managers, and spreadsheets, to process them as needed. There are two primary approaches to OCR, *feature extraction* and *matrix matching*.

Overhead scanner A desktop scanner that looks like an overhead projector. It scans documents and objects from above; documents must be placed face-up on the scanner's flat scanning surface. Also called a copyboard scanner. (See also *desktop scanner*.)

Page scanner A scanner capable of scanning an entire page at a single pass, instead of requiring multiple passes over different portions of the page in order to scan the entire page. Most desktop scanners are page scanners, while hand-held scanners are not.

Palette color A limited-color approach to representing color images in TIFF image files. Typically, 8 bits are stored for each pixel, to represent the color of the pixel. The 8-bit palette value for each pixel then becomes an index into red, green, and blue color tables that determine the actual color of the pixel. (See also *RGB color*.)

Parallel port The standard IBM printer port, which is found on most PCs. It's used for connecting to a printer with a Centronics-compatible interface. This interface is sometimes used to connect scanners to PCs.

Pixel A contraction of *picture element*. A pixel denotes the smallest piece of an image (a dot) distinguishable by a scanner or output device. A scanner that scans 300 dots-per-inch (dpi), for example, actually distinguishes 300 pixels every linear inch.

Preview A fast, low-resolution scan of an image. A preview is used to adjust the scanner settings and/or to select which portion of the image is to be used for the full scan. Also called a prescan.

CONTINUED

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er cable. Note that some desktop scanners include retaining screws to keep their internal mechanisms from being damaged during shipment. Although this information is generally clearly indicated on the scanner itself, it's well to check the documentation before turning on a new scanner, for attempting to operate it with retaining screws in place could harm the unit. Similarly, to protect the internal mechanism, any retaining screws should be reinserted before shipping the scanner or moving it any substantial distance.

Once the hard(ware) part is done, it is time to install the software supplied with the scanner. This may include a driver to be referenced in your CONFIG.SYS file, a command line to be placed into your AUTOEXEC.BAT file, a simple executable file, or any combination of the three. A number of desktop scanners require software to be downloaded to the scanner from the PC for initialization or for special operations such as optical character recognition.

When the scanner software is executed at power-up, it typically tests the interface between the PC and the scanner. If a healthy level of communication is not found, an error message is displayed, though it often goes by so quickly that it's easy to miss. Bad cable connections or a mis-set interface configuration are the usual culprits if the scanner does not work initially.

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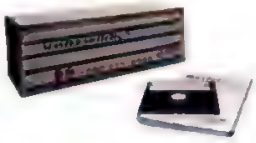

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While many scanned images are usable "as is," often a few changes should be made before an image is included in your application. Perhaps lines should be added or deleted, the image should be rotated or cropped, or the gray-level shading should be altered to effect a different tone. These and similar modifications can be accomplished via standalone graphics editors or those found in popular paint programs.

PC Paintbrush, from ZSoft Corp., is the leading paint program, and most scanners support its .PCX graphics file format. The program's graphics-editing features include airbrushing, gradient fills, rotation, outlining, color redefinition, resizing, cropping, and more. It can also perform a certain amount of gray-scale manipulation.

A second popular paint program capable of accomplishing most of the commonly desired editing functions is *Dr. Halo,* from Media Cybernetics. Other programs you may wish to consider include *Inset* (Inset Systems), *The Graphics Link Plus* (HSC Software), *Hot Shot Graphics* (Symsoft), *Pizazz Plus* (Application Techniques), and *Publisher's Paintbrush* (ZSoft).

Gray-scale images present additional complexities that may require a special breed of software to edit effectively. Simple graphics editors, for example, implement a gray scale by grouping dots together in a dither pattern. The group of dots then becomes the new gray-scale dot (pixel) for the halftone (gray-scale) image. There are two primary drawbacks to such a procedure. First, the larger pixels reduce print resolution. Printing a 300-dpi scanned image on a standard 300-dpi laser printer with a 4-bit dither pattern (16

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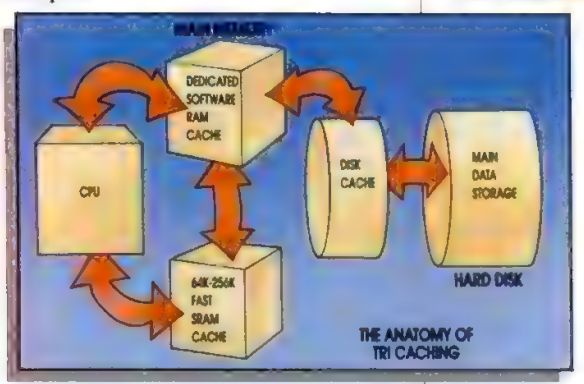

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shades of gray) reduces the print resolution to about 75 dpi, which is approximately newspaper quality. The second disadvantage of dithering shows up if the graphics editor resizes the image. As the size is increased, the image begins to lose its continuous-tone photographic appearance and to look increasingly "digital" or computer-generated.

While most of the simpler graphics editors can handle gray scale only by generating a dithered bitmap output, there are several programs specifically geared toward more-sophisticated gray-scale image editing. These gray-scale editors can effect changes in contrast, brightness, and tone in all or in portions of an image. Some go even further and allow image retouching, line smoothing, and other effects. Note, however, that while most of these packages will work with up to 256 shades of gray, few video adapters and monitors can visually support such a wide gray-scale spectrum. Even VGA will display only 64 shades of gray.

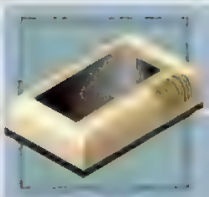
One of the more-advanced gray-scale editors is *Picture Publisher*, developed by Astral Development Corp. and sold by Microtek. (Other companies may soon be offering it, as well.) *Picture Publisher* runs under *Microsoft Windows* and requires VGA video. It provides not only the standard gray-scale editing functions, but special masking techniques and output customization, as well. It is, however, limited to the 64 gray levels supported by VGA.

Other gray-scale image editors include *Snapshot* (BioScan), and *ScanDo* (Hammerlab). As mentioned above, *PC Paintbrush* now also incorporates some gray-scale editing features, and Xerox has indicated that it may release a gray-scale image editor to complement its *Ventura Publisher*.

HARDWARE HELP FOR GRAY SCALES

Although much resolution is generally lost when a gray-scale image is printed on a standard 300-dpi laser printer, printing and typesetting companies often use laser typesetters that can print at far higher resolutions than are available in the average office. Two currently popular laser typesetters are the Linotronic L-100 (1,270 dpi) and L-300 (2,540 dpi) models.

When magazines print halftone images, they use variable dot sizes and densi-



SCAN THE TERMS

CONTINUED

Raster image An image made up of a matrix of dots or pixels. Scanned images and images displayed on a standard computer monitor are examples of raster images.

Resolution A measure of how many pixels per inch a scanner is capable of viewing. Resolution is generally measured in dots-per-inch (dpi).

RGB color A wide-spectrum approach to representing color images in TIFF files. Twenty-four bits are stored for each pixel to represent the color of the pixel: 8 bits for each primary color—red, green and blue. So, for example; 7, 7, 7 is white; 0, 0 ,0 is black; and 0 green, 6 red, and 5 blue is a variation of magenta. The result: over 16 million possible colors. Note: with RBG color, the numbers are directly proportional to the amount of color specified, whereas with palette color, the amount of color is determined by looking at a table. (See also *palette color*.)

Scan To convert an image from a document or photograph into a digitized form that can be stored on, and processed by, a computer. The resulting digital image is also called a scan.

Scan rate The speed at which a scanner can scan an image. It is normally measured in seconds per page for desktop scanners and inches per second for hand-held scanners. The scan rate of a desktop scanner often varies based on the scan resolution selected.

SCSI (Small Computer System Interface) An American National Standards Institute (ANSI) standard computer parallel interface capable of sending 8 bits at a time. It is frequently used to interface scanners to PCs.

Serial port A PC interface port often used to connect PCs to modems and other peripheral devices. The serial interface is relatively slow, capable of transmitting only a single bit at a time. It is sometimes used to interface scanners to PCs. The serial port is also called the RS-232 port, since the electrical interface follows the RS-232 standard established by the Electronic Industries Associations (EIA).

Sheet-fed scanner A desktop scanner that operates by automatically moving the document being scanned (a single sheet) through the unit with rollers, in much the same way as in a conventional fax machine. Also called a roller-feed scanner. (See also *desktop scanner*.)

Thresholding A method used to eliminate gray-scale information from a scanned image, usually for line art or similar black-and-white applications. A gray-level threshold is first selected; all pixels lighter than the threshold level are considered white, while all darker pixels are considered black.

TIFF (tagged-image file format) A graphics file format jointly developed by Aldus and Microsoft and universally supported by all image scanners. It allows two-tone (black-and-white), gray-scale, palette color, and RGB color images to be described.

Variable resolution A feature available on some scanners whereby any one of several supported scan resolutions can be selected by the user.

Vector image An image made up of line segments. CAD (computer-aided design) programs generally store images in a vector format (even though they are visually displayed on a raster monitor) since the images are typically output to pen plotters, which are vector devices.

Vectorization A method of converting raster image files, such as those generated by scanners, to vector image files, such as those used by most computer-aided design (CAD) software packages. ■

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ties to display different gray levels effectively. While this cannot easily be done on a standard laser printer (since all dots are the same size), a few companies have developed hardware that assists laser printers in producing high-quality gray-scale images without the severe loss of resolution that dithering imparts.

Intel's Visual Edge, for example, is a gray-scale controller that works with the HP LaserJet II and a 286 or 386 AT. The Visual Edge system includes two boards. One plugs into an expansion slot in your computer, the other into the LaserJet's video option port; a cable connects the two boards. The Visual Edge circuitry then takes over control of the printer's laser in order to vary the spacing between the printed dots. By changing the dot densities, gray levels can be added to the printed image. Using this method, a halftone image with up to 150 lines per inch of resolution (magazine quality) can be printed.

OPTICAL CHARACTER RECOGNITION

Optical character recognition, which converts scanned documents into ASCII text files, is one of the most exciting aspects of scanner technology. In the last two years capabilities that previously required a minicomputer and cost $50,000 have become available to the PC user at a fraction of that price. Even with its new-found relative sophistication, however, OCR still has much room for improvement, especially in handling the challenges presented by unusual or difficult fonts and tight character spacings. Even simple italicized characters are often too difficult to decode.

When using OCR, therefore, you should realize at the outset that even very *good* conversions can currently achieve only about 95 percent accuracy. If 5 percent of the character translations are incorrect, however, that's 50 characters (and potentially 50 words) on a 1,000-character (200-word) page. Even word-processor spell-checkers will not catch all of these errors, since some of the incorrect characters will result in other real words (*hand* may become *land*, for example). Thus, always be prepared to do very careful proofreading, since the errors that a spell-checker misses will be difficult for *you* to catch, as well!

OCR uses two primary approaches for interpreting characters from scanned images. The first is known as *matrix matching* or *font recognition*. In this approach, the software is initially "taught" the characters and symbols for the specific fonts supported, together with their corresponding ASCII values. To teach the software a new font, each character and symbol of the new font is stored (typically by scanning) as a matrix of bits representing the shape of the character or symbol. Many OCR programs come with matrices for standard fonts, so you have to teach them only fonts not already included. In operation, the software compares each scanned character with the prestored characters, looking for a match. When it finds a match, it puts the ASCII code for the character into its output text file. (See "Two Approaches to Optical Character Recognition," *PC Magazine*, November 29, 1988.)

The other approach to OCR is known as *feature extraction*. Also known as *feature recognition*, *pattern recognition*, or *topological analysis*, this more generic approach involves comparing the characteristics of the scanned characters with a list of features each character is known to have. For example, the software might list the features of the letter *b* as "a vertical line with a connecting semicircle on the lower-right portion." These basic features are independent of the specific print font being used. When it finds these features in a scanned character, the program sends the corresponding ASCII code (62h for *b*) to the output file. (See "Two Approaches to Optical Character Recognition").

> In the last two years OCR capabilities that previously required a minicomputer and cost $50,000 have become available to PC users at a much reduced price.

OCR packages that use feature extraction are often called omnifont packages. Feature extraction requires a little more intelligence than the matrix-matching approach, but it generally offers more flexibility in handling numerous different font types.

Scanners designed strictly for OCR often use an internal firmware-based OCR program, and are known as text scanners. Most scanners, however, rely on third-party PC software to convert the scanned document image into an ASCII text file. This, of course, offers the greatest flexibility, since there are many OCR software packages from which to choose—and some are quite good. Even scanners that perform OCR internally can take advantage of PC-based third-party OCR packages, as long as the scanner is also capable of outputting an image file in TIFF format.

One currently popular OCR software program is *OmniPage*, from Caere Corp. This package requires a 386 processor, otherwise you can buy an optional processor board that will allow the program to work in a 286 system. *OmniPage* uses the feature-extraction approach, and while it cannot generally handle italicized fonts, it can handle a wide variety of standard fonts. Another popular omnifont OCR package, *TrueScan*, from Calera Recognition Systems, comes with a coprocessor board that plugs into your 286 or 386 AT-compatible machine. Other current OCR packages include *Read Right* (OCR Systems), *Spot OCR* (Flagstaff Engineering), *PC-OCR* (Essex Software Publishing), *CAT Reader* (Computer-Aided Technology), and *Catchword* (Logitech).

A number of scanner manufacturers offer OCR software specifically designed to operate with their own machines. DEST, for example, offers its new *Recognize!* for the PC Version 2.0 software, for the company's 2000 and 3000 desktop scanner series. It also works with Hewlett-Packard and Microtek scanners and requires an AT or compatible system. *Recognize!* can even handle bold fonts and italics.

Another scanner manufacturer, Advanced Vision Research Systems, offers the trainable (matrix matching) *MegaRead* OCR software for use with its scanners. And if your needs can justify the rather hefty price of $15,950, Xerox Imaging Systems offers its advanced Kurzweil Model 5000 OCR system, which includes scanner, software, and adapter board.

CHOOSING A SCANNER

As we've seen, there are many hardware and software options to consider when purchasing a scanner. The November 29, 1988, and March 28, 1989, issues of *PC Magazine* contain reviews of specific

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Out of the twenty-four 486 computers tested and evaluated by *PC Magazine*, one—and only one—won the prestigious Editors' Choice Award: Elegance 486. And, Elegance was the only 486 to score over 9.0 on *InfoWorld's* Report Cards. (In fact, the closest competitor scored 8.2 and costs THREE TIMES AS MUCH!)

The fuel behind Northgate's state-of-the-art power! The 486 processor combines the capabilities of an enhanced 386, an advanced internal cache controller and 8K of supporting static cache memory. The chip also incorporates an enhanced 387 FPU (Floating Point Unit). In short, this gives you increased performance for the most demanding math-based applications.

Northgate caching enhancements give you greater speed! We've added a 64K read write-back SRAM cache (expandable to a Northgate exclusive 256K) to further accelerate the execution of instructions. I/O transactions are faster than ever thanks to a 32K hard drive cache controller. Finally, we armed Elegance 486/25 with Smartdrive DOS disk caching software. Result? Processing speed you must see to believe!

Elegance 486i ISA is the perfect stand-alone, high performance graphics/software workstation and network server. Its multi-stage caching is an excellent match for tough number-crunching operations.

Elegant desktop and optional tower cases. Five bays on the desktop and seven on the tower offer plenty of room for all kinds of boards and for adding peripherals and internal or external devices.

a winner because of its wealth and, finally, performance."

PC Magazine
September 11, 1990

REPORT CARD		INFO WORLD
July 30, 1990		
High-End Workstations/ File Servers	(InfoWorld weighting)	**Northgate Elegance 486 25i**
Workstation Configuration		
Price (as tested)		$6,195
Server Configuration Price		$8,895
Workstation Performance		
Speed, CPU-intensive applications	(100)	Very Good
Speed, disk-intensive applications	(100)	Excellent
Software compatibility	(150)	Excellent
Hardware compatibility	(125)	Excellent
Expandability	(75)	Excellent
File Server Performance		
Speed, office applications	(300)	Satisfactory
Speed, transaction	(125)	Good
Speed, burst transfer	(25)	Excellent
Expandability	(100)	Excellent
Documentation	(50)	Excellent
Setup	(100)	Good
Serviceability		
System design	(50)	Good
Support policies	(50)	Excellent
Technical support	(75)	Excellent
Workstation Value	(125)	Excellent
File Server Value	(125)	Very Good
Final Workstation Scores		9.1
Final Server Scores		7.1

Build up from our base! Northgate's modular system approach lets you add only the components you need. Our base system includes 4Mb of memory (expandable to 16Mb), your choice of 5.25" or 3.5" floppy drives, power supply, case and exclusive *OmniKey/PLUS* or ULTRA keyboard.

For heavy duty storage, our hard drive options range from 100Mb to dual 600Mb hard drives with super fast 15ms access. Make sure to ask about our VGA monochrome and color cards and monitors; Weitek math coprocessors; floppy, CD ROM and optical drives; Mountain tape backups; printers and other powerful peripherals!

Or select our Power System with 4Mb of RAM, a 200Mb Maxtor hard disk with 15ms access, 1.2Mb 5.25" and 1.44Mb 3.5" floppies, a 14" SVGA color monitor and an *OmniKey* keyboard. Comes complete with Microsoft® Windows™ 3.0, Samna® Ami™ Professional word processing software and Wingz™ graphics spreadsheet and database software. This $1139.00 value software is yours at NO EXTRA CHARGE!

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Elegance 486i ISA Power System Features

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- 200Mb Maxtor hard drive with 15ms access; 16-bit controller with 1:1 interleave; 32K disk read-look-ahead cache buffer
- 64K SRAM memory cache; read/write-back caching
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- Eight expansion slots; one 32-bit slot; six bit and one 8-bit slot
- Weitek math coprocessor support
- One parallel and two serial ports
- 16-bit SVGA with 1024 x 768 resolution; 512K video memory
- Clock/calendar rated at 5 years
- 200 watt power supply (220 watt power supply in tower case)
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- Front mounted reset and high/low speed controls
- Exclusive Northgate *OmniKey*™ ULTRA keyboard
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scanner models. These should prove helpful once you've narrowed the field to units that meet your overall application requirements. A review of the relevant considerations follows.

In determining what image quality you can live with, you're essentially dealing with what resolution and how many gray scales are acceptable and whether color is needed. Scan rates vary among scanners, with faster scanners, of course, tending to be more costly than slower ones. Remember, too, that while many scanners now offer 256 gray levels—even at 300 dpi resolution few output devices can take advantage of this much information. A 64-gray-scale scanner is generally better suited for most standard halftone image scanning. If you want to keep cost to a minimum and expect to be scanning only line art (black and white images), a simple two-tone scanner will suffice.

Moreover, while desktop scanners offer the best scan results, low-cost handheld scanners are acceptable for applications that involve only small line art and graphics images, such as company logos. Of the desktop units, flatbed scanners generally offer the greatest flexibility and accuracy and are correspondingly the most expensive choice. Sheet-fed scanners also provide good scanning results but can't handle bound materials. Overhead scanners offer the ability to scan small 3-D objects but at higher resolutions do not generally offer the same scan quality as the flatbed and sheet-fed units, since the image is further away from the scanhead.

For any graphics scanner, you must also make sure the scanner supports the software you will be using. If your graphics software supports TIFF, you will have no problem, and the *PC Paintbrush* .PCX format is also supported by most. Any other file format will probably require the use of a format-translation program, and while this is acceptable for occasional applications, it can be a burdensome extra step if required for every scanned image.

If you will be doing OCR, you will want a fairly high-resolution scanner: at least 200 dpi, with 300 dpi or higher preferred. Again, make sure the scanner works with the OCR software you are considering. While most OCR programs will work with any TIFF file, some are designed to work only with certain scanners. And even among OCR packages that can decode information from TIFF files, some, such as Dest's *Recognize!*, work more efficiently when allowed to operate directly with the specific scanners for which they are designed.

In determining your system requirements, bear in mind that many scanner software packages will not work on an XT system, but require an AT (286 or 386) system. This is particularly true for OCR. System RAM is also a concern. Scanned graphics images can take up a lot of memory, and many graphics editors bring the entire image into RAM before editing, so 1MB to 4MB of extended or expanded (EMS 4.0) memory is often required.

Similarly, you must make sure your hard disk has enough room to store the scanned images. And if you need to archive scanned images or transfer them to another system, remember that the image files will probably be too large to fit on a floppy diskette, so you'll need a tape drive or other transfer device.

Scanner technology is evolving rapidly, with improvements both in hardware and software being introduced constantly. Higher resolution is becoming more commonplace and will continue to be an area of scanner improvement. Several color scanners are already available, though, like color laser printers, they are expensive and only limited software is presently available to support them. Proving that color scanners can be cost effective, Microtek recently introduced its MSF-3002 color scanner for under $2,700. Finally, scanner support software—the piece of the puzzle that makes these hardware wonders useful in real applications—is being continually refined and improved. This, perhaps, will be the biggest area of scanner technology advancement.

The Spanish government recently began an ambitious project to archive 9,000,000 documents related to Columbus's voyage with the Niña, Pinta, and Santa María. An image database will be stored on optical disks and will eventually be available to libraries throughout the world. This is a good example of how scanners are being applied in applications that could not even have been considered a few years ago. The future holds many more, including some that are sure to touch on your own productivity. ■

Roger C. Alford is a design engineer and the author of two books and many articles on computers and electronics.

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Please complete all appropriate sections, providing at least two year's residence and employment history. This will enable your application to be processed as quickly as possible. If you are self-employed, please be sure to complete section "D" on back.

Applicants must be 18 years of age or older.

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Requested Line of Credit $ _____

Your Name: First Initial Last **Date of Birth:** Mo Day Yr **Social Security Number:**

Present Address Street Apt. # City State Zip **Home Phone** ( ) –

Date of Residence: Month Year **Monthly Payment $** Buy Rent Other

Previous Address: **Dates of Residence:** From To

Your Employer: (If self-employed, see rear panel) **Date of Employment:** Mo Yr **Position:** **Monthly Income:** Gross $ Net $

Employer's Address: Street City State **Business Phone:** ( ) –

Previous Employer **Address:** **Dates of Employment** From To

Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation. **Other Income:** ____ I have received since (Date) Monthly Income Gross $ Net $

Name and Address of Nearest Relative Not Living With You Relationship

b. Credit Information

Include joint applicant's information if joint account requested

Bank Account: Bank Name Address Checking Savings

Bank Account: Checking Savings

	Payment	Balance
Bank Loan References:		
Bank Card References: VISA MasterCard		
Other Credit Card Reference		
Other Credit References: Account No Expires		

Driver's License No State Expires

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Address Street Apt. # City State Zip **Date of Residence:** Mo Yr **Home Phone** ( ) –

Employer **Date of Employment:** Mo Yr **Position** **Monthly Income** Gross $ Net $

Employer's Address: Street City State **Business Phone** (–

d. Self-Employed Information

Complete this section only if you are self-employed

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Business Address Business Telephone ( ) –

Description of Business Your Position In Business Since

Your annual income from business Business annual income (gross) (net)

You must provide at least one of the following:

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2. Accountant's Name Telephone ( ) –
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by
Jay Munro

Utilities

PCBOOK Makes Your LaserJet Print Files In Booklet Form

A README disk file is a convenient way for a software seller to extend the life of his already printed documentation, but at best it's a nuisance for the buyer. COPYing README to PRN simply produces a mass of unnumbered pages that don't even fit within the documentation package. And trying to reformat the file with your word processor not only takes a lot of time, but usually still sends you looking for the paper cutter.

PCBOOK eliminates all this hassle. It prints your README (or similar) files on double-sided pages arranged so that with one fold they become a neat little brochure that fits right into the regular documentation booklet or diskette sleeve. All you have to do is select the file and options—which include automatic page numbering—and reload the paper once, in order to print the back side(s).

PCBOOK is designed to work with an HP LaserJet Series II, IIP, or III. No additional printer memory or external fonts are required. Because it prints in landscape mode, on both sides, and uses the built-in Line Printer font rather than the larger, default Courier, PCBOOK can put four standard pages of 80 characters per line, 66 lines per page, on a single 8½- by 11-inch sheet. The formatting of the original file is retained, so indenting, columns, or code listings will print out correctly.

The easiest way to get a copy of PCBOOK is to download its .EXE file from PC MagNet, as explained in the sidebar "PCBOOK by Modem." The source code, PCBOOK.BAS, is written in QuickBASIC and can also be downloaded from PC MagNet. If you wish to customize the program (see the sidebar "Customizing PCBOOK"), you'll need Microsoft QuickBASIC 4.0b or 4.5, or Version 6.0 or 7.0 of the BASIC compiler.

If you do not have a modem, you can also get the source code by mail or fax by sending a *postcard* with your name, address, and fax number (if applicable) to Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; Attention: Katherine West. No phone calls, please. (Note: estimated fax length is six pages.)

■ The painless way to handle README and similar files is to turn them automatically into handy booklets.

USING PCBOOK

The full syntax for PCBOOK is

```
PCBOOK [path]filename [/F] [/P]
 [/D] [/C] [/2] [/A] [/W] [/S]
 [/H]
```

The *filename* can designate almost any regular text or ASCII file, including those created with *PC Magazine*'s TED.COM or Borland's *SideKick*. Each line of text must be terminated by a carriage return and a line feed character, and you may include form feeds (also called *page feeds*) to force page breaks within the text. Note that PCBOOK does not (by default) wrap lines with lengths greater than 80 characters. As explained in more detail below, text files with longer lines *can* be printed with line wrap (not word wrap) by including the /W switch in the command, though at the cost of a small degradation of speed. Since most README files never exceed the 80-character width of the screen, this switch option will be needed only occasionally.

When entered with a filename, PCBOOK begins by calculating the number of sheets needed for printout. After displaying this total, the program proceeds to print the front side. If you run out of paper on the first pass, you are given the option to reload and continue or to cancel. (It's a good rule of thumb to keep your paper tray filled at least half way; it helps avoid paper jams.) If you want to know the number of sheets of paper required before actually printing, start PCBOOK with the /C switch added. PCBOOK will pause after displaying the number of sheets the file needs. Now you can press ENTER to continue or hit the Esc key to cancel printing and return to the DOS prompt. After PCBOOK has completed printing the first side, it will prompt you to reload the pages in order to print the second side.

Reloading the half-printed paper is very easy. If you use the normal top-bin output to collect the printed sheets, simply transfer them back on top of the remaining sheets in the paper supply tray. Just be careful not to flip or rotate the pages in relation to the way they came out of the printer. The paper orientation through the LaserJet is text-side-up going in and text-side-down coming out, as illustrated in Figure 1. Note, however, that *if you use the rear output tray* on the LaserJet, you will have to turn the stack of sheets over before loading it into the paper feed tray for side-two printing. When you've reloaded the paper into the supply tray, press Enter to continue printing to the end of the file.

When its print job is complete, PCBOOK displays a message on the screen and returns you to the DOS prompt.

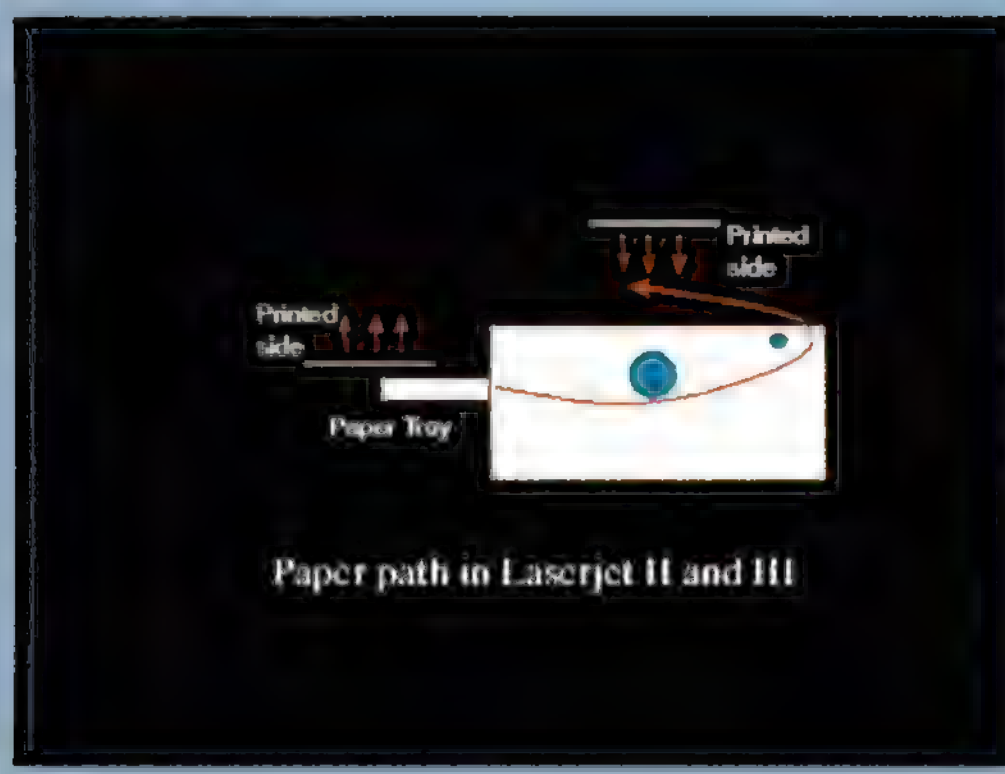

Figure 1: In normal printing, the LaserJet printers turn the paper over for you, so to print the sheet(s) on side two, you merely reload the half-printed sheets without changing the way they have come out of the printer.

All you need to do then is to staple or fold the booklet together. Naturally, before running the program, you should have your LaserJet turned on (unless you plan to select the /A switch as described below) stocked with paper, and on-line; some of the error messages have a long time-out before they appear.

PCBOOK OPTIONS

A printed header on each page is frequently useful, and PCBOOK has three optional switches for including header information. The /F switch prints the source filename in the center of the header; /P prints the current page number on the outside of the page; and /D prints the current date on the inside of the page. The header can use any or all three options. If a header is used, the text will start one line below and will still be 66 lines long. By default, the header, if used, will be printed on all but blank pages. (If you want headers on all the pages, see the "Customizing PCBOOK" sidebar for more information.)

LPT1 is the default printer port for PCBOOK. If your LaserJet is connected to LPT2, simply include the /2 switch when you issue the PCBOOK command. Note that since QuickBASIC supports only LPT1 or LPT2, these are the only parallel printer ports supported by PCBOOK. If you need to use the LaserJet in serial mode, use the DOS MODE command to set up the port and redirect from LPT1 or LPT2. (PCBOOK could be modified to use COM ports, but it's simpler just to follow the procedure explained in the DOS manual.)

Including the /A switch causes PCBOOK to prompt you for a filename instead of using LPT1 or LPT2. The file created will include all the printer commands that normally would be sent directly to the printer, so you need only copy the file to a LaserJet later to get your printout. The /A switch can also be used to force a dry run of the print by using the DOS device NUL as a filename. When you're in the process of modifying the program, this is a handy way to do your debugging without burning up reams of paper.

The /W switch instructs the printer to wrap lines that would otherwise extend beyond the right margin onto the next line. When PCBOOK is calculating page breaks, the extra lines are added to the count to keep pages printing correctly. The LaserJet wraps lines on a character basis, unlike a word processor, which breaks long lines on word boundaries. When the /W parameter is not used, PCBOOK defaults to line wrap off, so lines that extend into the margins will be truncated.

> PCBOOK has three optional switches that let you include header information on each page of the booklet.

Using the /H switch tells PCBOOK to display its syntax and a short description of all the switches, and then return to a DOS prompt. The /S switch, if used, adds a beep when PCBOOK successfully prints a side.

HOW PCBOOK WORKS

PCBOOK can create a booklet from a text file of any reasonable size. To overcome the problem of limited string space, PCBOOK makes use of a 513-element LONG INTEGER array called PtrArray&() to provide pointers into the file. Each element represents the location in the text file where a new page starts. The result is that 512 pages can be printed. The array elements used are always one more than the rounded-up number of pages. At 80 characters per line and up to 66 lines per page, the upper limit is a file of 2,642,240 bytes.

PCBOOK opens the text file as a binary file and reads it into a buffer. The buffer is scanned for line feed (LF) and form feed (FF) characters, using BASIC's INSTR function. If both are found, the form feed position is compared with the line feed position. If the form feed is closer to the start of the scan, the page count is incremented and the offset into the file is recorded. If the line feed is closer, then the current line count is incremented. The page is incremented and recorded when the line count reaches 66 lines, and the line counter is cleared to start again.

As the buffer is exhausted, another portion is read from the file; this continues until the whole file is processed. The input file is then closed and the last element of the pointer array is set to the length of the file.

The actual printing begins with clearing the LaserJet of any temporary macros, temporary fonts, and text and margin commands that may be left in the printer from earlier use. (Hewlett-Packard recommends resetting the LaserJet at the beginning and end of every print job.) All the commands used in PCBOOK are temporary and will be cleared at the end of the printing.

First, PCBOOK selects the escape sequences to put the LaserJet into landscape mode. Then it selects the sequences for the Line Printer font and the Pitch and turns off the default perforation skip. (The default setting of the perforation skip causes the LaserJet to eject a page when the printing goes past the number of lines set on the

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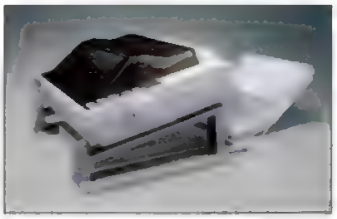

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front panel. Since PCBOOK prints up to 68 lines per page when using a header, this would create a problem.)

The Macro function is a very handy, though underutilized feature of the LaserJet Series printers. You can create up to 32 macros with a standard Series II (up to 32,768 macros using a Series IIP or Series III and enough printer memory), and they can be called with a single command. Using printer macros to control the margins of the left and right side of the sheet reduces the number of commands sent to the printer for each page.

An escape command is sent to signal the start of the macro. Almost any instruction that follows can then be recorded and assigned to the macro. To terminate the macro, another escape sequence is sent to show where to stop. The macro is then defined as either permanent or temporary. For our purposes, the macros are made temporary, and so will be cleared at the end of the job.

The actual printing of the text file is done using BASIC PUT and GET statements using pointer array values that correspond to the page to be printed. For example, to print page 3, the value in element 3 is subtracted from element 4 to determine the length of page 3. A string buffer is created with this length, and the whole page is read from the text file into the string with BASIC's GET using the value in element 3 as the SEEK (or starting) point in the file. The string is scanned for a line feed character; in its absence, PCBOOK prints the entire buffer string. If a form feed is present, the string is printed up to, but not including the form feed. Because the LaserJet printer recognizes carriage returns, line feeds, and form feeds, the whole page can be sent to the printer in one print command. Printing the complete page string is much faster than printing a line at a time.

Booklets must always have an even number of sheets, and the total page count must be rounded up to the next multiple of 4. Once rounded up, the number of pages is divided by four to reflect the number of

CUSTOMIZING PCBOOK

by Jay Munro

A QuickBASIC program like PCBOOK should not, by any means, be considered untouchable. Starting from the basic working program, you should consider making modifications both to add desired features to the program and to further your knowledge of programming in general. As you trace through the source listing of a program, your imagination should set you to asking yourself, "What if . . . ?" To jump-start your creative juices, here are a few suggestions.

Printing the filename on every page is fine for program listings, but a title like LGR4DEC.TXT might be a bit cryptic for the general user. By adding an input statement to prompt for a descriptive title, the header could be made clearer. A new switch, such as /T, could trigger the prompt and set the PC.DoHeader flag for printing. A one-line title of up to 80 characters could then be added comfortably. Since a LaserJet macro may contain the text as well as the printer commands, your title could be loaded into the printer only once as a macro and called by number to be printed.

While you're at it, perhaps the page numbers would look nicer in a footer. Just set up the page numbers in the same manner as in the current header, but print the string at the end of the page instead of the beginning. After printing the page, use LJLocate to position the LaserJet cursor at line 68 and print the string.

To put a larger amount of text on each page, legal size paper could be substituted. Modify the macros one and two for wider margins and change PC.LineLen to the maximum number of characters that will fit in between. You may want to experiment with the lengths of the lines by creating a simple test file of numbers 1234567890, repeating on each line. Then, when you print the file, count the zeros as ten (characters) and add the last number to find the length of a line with the new margins. For example,

```
1234567890123456789012345678901234
```

is 34 characters long. Of course, you must not use the /W option at this time.

The best place for a program README file is with the original documentation. Depending on the method of binding or finishing your booklets, the center area or gutter of the pages produced by PCBOOK may need to be adjusted. To accommodate a three-hole punch, the PC.LineLen value should be made smaller and the center margins made wider.

To keep up with the latest fads in documentation, any extra blank pages that must be added when the text comes up short could be printed with the classic "This page intentionally left blank." Alternatively, you could be creative, with "This page is not really blank is it?", or "This space for rent, inquire . . . " Again, a LaserJet macro would fit the bill nicely.

As hinted in the text, users of Microsoft's Professional Development System may want to replace the OPEN for INPUT section—that tests for the existence of the text file—with the new DIR$ function. The line

```
IF LEN(DIR$(Filename$)) = 0 THEN
 GOTO GetName
```

will check the file without ON ERROR. Because the check is now contained locally, the user input section can be moved to its own module, making a cleaner program. The DIR$ function may also be used to add multiple file printing. An array of filenames can be created and fed to PCBOOK for printing.

PCBOOK works best on files of at least three or more pages, but for single or two-page files, a special condition could be added to print only on one side of the paper.

Finally, to print a header on every page, whether blank or not, remove the

```
IF PC.DoHeader THEN
```

statement from the two-page printing routines under the DoPass label. Calling Header prints every page with the header information. ■

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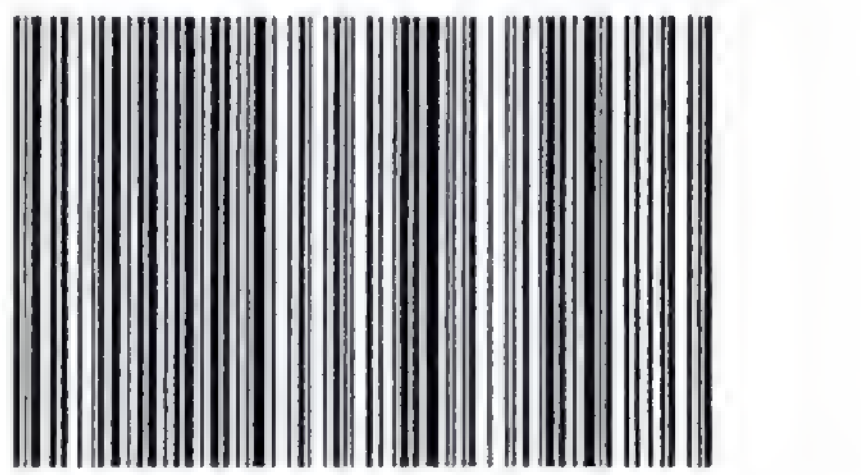

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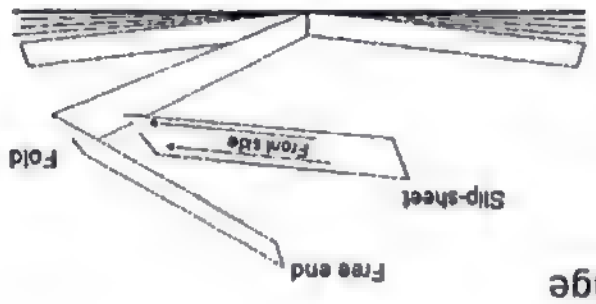

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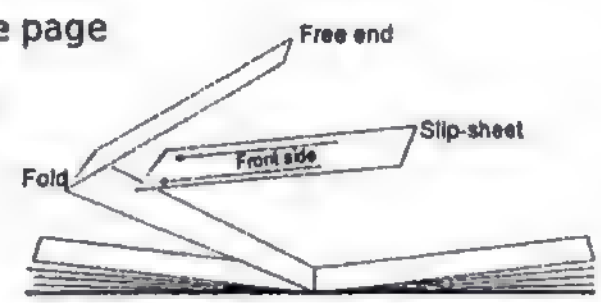
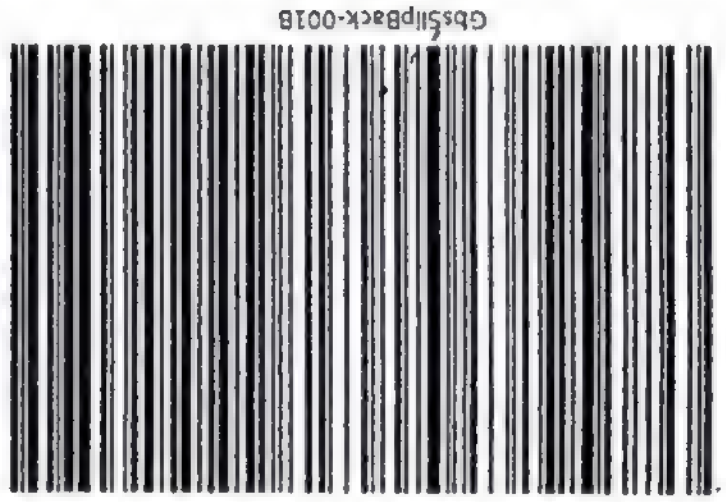


Inverted Back

1. Follow instructions on the other side



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sheets to be printed. For example, a 41-page file will be rounded up to 44 pages, resulting in 11 sheets being printed upon, though the last three pages will be intentionally blank.

To create a two-sided booklet in the correct format, the pages cannot be printed sequentially. On the first pass, printing starts with the first page (page 1) on the right and the last page on the left. The pages are increased by two on the right and decreased by 2 on the left. At the end of the first pass, half the pages in the file have been printed on the paper. To print the other side, the sheets are reloaded into the paper tray. The second pass starts with the center of the book—pages 21 and 22 in the example above—and continues incrementing and decrementing the pages by 2 until done. In this way, when the sheets are removed from the printer and folded in half, the pages will be in the correct order for reading.

A PROGRAMMING OVERVIEW

PCBOOK has four major sections: (1) initialization, command-line parsing, and user input; (2) input file processing; (3) printer setup; and (4) input file printing.

The initialization portion of PCBOOK assigns default values to many of the variables that are subsequently used throughout the program. Even though PCBOOK is a modular program, it is still a single BASIC file, and so can use shared variables. Sharing certain variables cuts down on passing often-used values. Furthermore, PCBOOK represents all numeric data using integers (short or long) for speed and smaller code size.

> PCBOOK represents all numeric data using integers for speed and smaller code size.

THE COMMAND LINE

QuickBASIC provides a reserved string variable called COMMAND$ for all command-line input, and PCBOOK uses the command line as the main entry point for parameters. Unlike C, which parses the command line into separate arguments, QuickBASIC users must parse the line manually. To keep the program size down, PCBOOK is coded to expect the *filename* parameter first, though optional switches thereafter may be entered in any order. LTrim$ is used to trim leading spaces that could inhibit the parsing of the filename. If the first character encountered is a /, PCBOOK assumes that no filename was specified and prompts you for one.

QuickBASIC's powerful INSTR function is used extensively throughout PCBOOK to scan strings for matching characters. INSTR takes a source string and a search string argument and, with an optional starting-position argument, returns the position within the search string

TALKING TO YOUR LASERJET

by Jay Munro

To many programmers, LaserJet escape sequences look like hieroglyphics. But while a statement like

```
ESC(8UEsc(s0p16.67h8.5v0s0b0T
```

looks so fearsome as to stifle any thoughts you may have had about programming your printer, the LaserJet language (PCL) is really quite easy to understand. Moreover, it's an extremely powerful text-and-graphics printing language. By knowing a little about how PCL is structured, you will be on your way to designing your own LaserJet programs.

PCL is divided into two types of commands: control codes and escape codes. Control codes are single characters, such as carriage return (Ctrl-M), line feed (Ctrl-J) or form feed (Ctrl-L). Printing control codes in BASIC is usually done by sending the appropriate CHR$() character, for example, CHR$(12) for page feed.

Escape codes are commands that have two or more characters, the first of which is always an ASCII ESC character (in BASIC, a CHR$(27)). The ESC character is a signal to the printer that the following character or characters are a printer command.

PCL escape commands are further divided into two types, two-character escape sequences and parameterized escape sequences. Two-character commands consist of the ESC character and one other character. The printer reset command, ESCE, is an example of a two-character command.

The parameterized escape sequences are the heart and soul of the PCL language. The escape sequence shown in the first paragraph is an example. Within a parameterized sequence, ASCII characters can function either as data or can represent the type of command or data. The following example shows the escape sequence to position the LaserJet cursor at the fifth row.

```
ESC&a5R
```

The five components of this sequence break down thus:

ESC—the normal ASCII escape character.

&—a character—an ASCII character with a value from 33 to 47 decimal (! to /)—that signifies that the escape sequence is *parameterized*, that is, that the printer is to expect more characters in the sequence.

a—a group character—an ASCII character with a value from 96 to 126 decimal (' to ~)—that specifies the group to which the command belongs. The "a" group affects cursor-positioning and margin-control commands.

5—a value field. Depending on the command, this field may be actual data or an index to the group of commands. In this example it's the number of the row at which to position the cursor. Font control sequences use this field to specify action to take on the last font specified.

R—the termination character—an ASCII character with a value from 64 to 94 (@ to ^)—signifies the end of the command and the parameter (in this case the row) to which it applies.

This sample parameterized se-

where a match begins. A 0 is returned if no match is encountered.

PCBOOK scans for each / switch separately and sets flags or variables accordingly. The /F, /P, and /D switches are grouped together and printed if any or all are specified. The header module creates a blank string 80 characters long, using MID$() to position the filename, page number, and date within the string for printing. If any of the three header switches is set, the PC.DoHeader flag is also set to signal that a header is to be used.

When the program starts, it must check for the existence of the input file. QB's ON ERROR facility is used in conjunction with the

```
OPEN filename$ FOR INPUT AS #1
```

statement to force an error if the file is not found. If the error is generated, the program will resume at the file-input prompt to try again. Programmers using Microsoft's Professional Development System may use the DIR$ function to accomplish the same thing. It may seem redundant to open the file just to see whether it exists: after all, the file will be opened for use in only a few lines. However, when the file is opened for use, it is with the FOR BINARY qualifier. When QuickBASIC opens a file variable for binary I/O and the file does not exist, it is simply created, and no error is generated. Thus PCBOOK would try to open it and try to print a zero-length file.

After the input file has been established, the COMMAND$ is checked one last time for the /A switch. If it finds an /A, PCBOOK prompts the user for an alternative filename or device. The OutFile$ default of "LPT1" or "LPT2" is changed to the new name.

INPUT-FILE PROCESSING

The BuildArray module is the core of PCBOOK and is called by the main module. The text file is opened FOR BINARY as #1 and read into the Buffer$. Using BASIC's INSRT function to scan for page feed and line feed characters, it locates virtual page breaks and stores them as an array of pointers into the text file. Using the full syntax of INSTR to scan the Buffer$, the parameter StPtr% is used as an offset or starting point within the string. The positions of the matches are recorded with TempLn% and TempPg% for line feed and form feed, respectively. As matches are found, the StPtr% is updated to point to 1 byte or character past the last match. By sliding the StPtr% along, the whole string is eventually scanned for form feed and line feed characters.

The actual pointers into the text file, PtrArray&(), are built by adding the position of the form feed in the current Buffer$ to the Offset& variable. Offset& is a pointer into the text file at the point where the buffer was last read. Offset& is updated on every Buffer$ read by adding the last Offset& to the length of the last Buffer$. StPtr%, the current position variable for the buffer, is also initialized at every read to ensure valid data.

The size of the file is found using the LOF() function. This information is kept

---

quence performs only one function: it positions the cursor on a specific row (5). To position it at a specific column (6), for example, another similar sequence must be sent

```
ESC&a6C
```

As you can probably imagine, sending all those ESC sequences could get very cumbersome. Fortunately, PCL offers a shortcut.

When the same parameterized and group characters are used for a number of commands, the multiple escape sequences can be combined, thus reducing the number of characters to be sent. To send the two commands above separately would require 10 characters. They can, however, be combined in the following way:

```
ESC&a6c5R  (=ESC&a6C + ESC&a5R)
```

In this sequence the ESC, parameterized, and group characters are not repeated, reducing the number of characters from 10 to 7—a 30 percent saving on overhead. The termination character (R) remains in uppercase, but all other alphabetic characters (in this case, only a c) become lowercase.

When escape sequences are combined, the commands are executed by the printer from left to right. In the above example, the LaserJet cursor is positioned at the sixth column first and then on the fifth row. In some situations the order of commands can be important, so knowing how commands execute could prevent bugs.

To use PCL commands from QuickBASIC programs, send all commands as strings. PCL commands can be built by concatenating strings and values to create a single string to send to the printer. Using our above example, the QuickBASIC syntax is

```
LPRINT CHR$(27);"&a";
LTRIM$(STR$(Col%));"C";
LTRIM$(STR$(Row%));"R";
```

The two integer values, Col% and Row%, must be converted into strings by the STR$ command, and the LTRIM$ functions remove the leading space that STR$ puts on. Occasionally, QuickBASIC, Version 4.0 and later, has problems with complex string concatenations. If you find problems printing certain concatenated strings, the workaround is to create a temporary string first, then print the temp. For example:

```
Temp$ = CHR$(27);"&a";
LTRIM$(STR$(Col%));"C";
LTRIM$(STR$(Row%));"R"
LPRINT Temp$;
```

For more information about PCL and programming the LaserJet printer, get a copy of the technical reference manual for your model. Unlike many such references, the Hewlett-Packard manuals are written in clear and concise language and cover almost every aspect of programming the printer.

Now that you have gained this much insight into the LaserJet language, try to decode the lengthy first example. (Hint, it's from the font test printout on a LaserJet III.) ■

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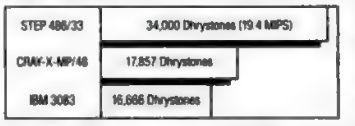

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PCBOOK Command

Jay Munro — October 16, 1990 (Utilities)

Purpose: Prints README and similar ASCII files in booklet format on an HP LaserJet II, IIP, or III printer. Uses two-sided printing in landscape mode, with Line Printer font so that four standard pages of 80 characters per line, 66 lines per page are printed on each sheet without formatting changes.

Format:

```
PCBOOK [path]filename [/F] [/P] [/D] [/C]
 [/2] [/A] [/W] [/S] [/H]
```

Remarks: The *filename* can designate any ASCII text file in which each line is terminated with a carriage return/line feed combination. Form feed characters can be added to force breaks in addition to those implicit in the 66-line (68-line if a header is used) page length.

Any or all of the /F, /P, and /D command-line switches can be used to create a one-line header that prints the filename, page number, and date, respectively, on all but blank pages. The /W switch causes lines exceeding 80 characters to wrap; by default such lines are truncated. Adding the /2 switch causes PCBOOK to print to LPT2 rather than the default LPT1. (Use the DOS MODE command to implement serial connection, if desired.) The /A switch can be used to direct output to a file.

PCBOOK sequences the page printing so that all side-one pages are printed in one pass. The sheets are then put back into the LaserJet paper tray and all side-two pages are printed. The finished booklet can then be created with a single fold. When using the normal (top) LaserJet output bin, the pass-one sheets should be reinserted in the paper tray without any relative change in orientation. If rear output from the printer is used, the sheets must be turned over as a group before reinsertion. To determine how many sheets will be required without automatically starting the print operation, use the /C parameter.

The /H parameter provides on-screen help for the program, and /S sounds a beep as each printing pass is successfully completed.

The source code for PCBOOK.EXE is written in QuickBASIC, and modifications will require Microsoft QuickBASIC 4.0b or 4.5, or the BASIC compiler, Version 6.0 or 7.0. Both the executable and the source files for PCBOOK can be downloaded from PC MagNet.

in the TotalSize& variable. TotalSize& is compared with Offset& before each Buffer$ read. When the value in Offset& is equal or larger than TotalSize&, the operation is complete and the file is closed. Because BASIC's GET uses the length of the Buffer$ to determine how many characters it reads, TotalSize& is also used to resize the Buffer$ when the file has fewer characters left than the default BufSize%.

PCBOOK uses PtrArray&() values to SEEK into the text file at the correct page numbers. The difference between the current PtrArray& value and the following one is the length of the page in characters. In order to calculate the size of the last page, the last PtrArray&() element is assigned to TotalSize&.

PRINTER SETUP

Once the PtrArray&() has been created, the printer is initialized by sending LaserJet commands with the PrintSetup module. Most LaserJet commands are prefaced by an escape character (BASIC CHR$(27)), so to simplify sending the escape codes, I created a shared variable, ESC$. PrintSetup first resets the printer with an ESC$;"E"; command. After the reset, an ESC$;"&l10"; is sent to set page orientation to landscape mode. Both the reset and orientation commands will cause the printer to print and eject any data left in the machine prior to the commands. Notice that every ESC$ string here has a semicolon appended. When using the Print # statement, QuickBASIC normally prints a carriage return and line feed after the string. If you place a semicolon after the string, however, the carriage return and line feed will not be printed. Without the semicolon, the ESC$"E'' would reset the printer and send a carriage return/line feed. When the landscape mode command is received, the printer would print a page and then continue.

The LaserJet macros used in PCBOOK are created by the HP macro-control commands. The ID code and start macro code, ESC$;"&f#y0X";, define the beginning of the macro with ID number substituted for #; for example,

```
ESC$;"&f2y0X";  'Macro ID number 2
```

Escape codes to be included in the macro are then sent. The macro is terminated with the escape code, ESC$;"&f#y1X'';; and then defined as temporary with an ESC–$;"&f#y9X"; code. (For more discussion of the LaserJet escape commands, see the sidebar "Talking to your LaserJet.")

PRINTING THE INPUT FILE

Now that setup and processing are completed, it's an easy ride from here. The actual printing of the text file is done a page at a time, read from a particular location in the file—but not in sequential order—with BASIC's GET command into the Buffer$. The process is similar to that followed in the BuildArray subroutine, except that the PtrArray&() is used rather than created. QuickBASIC's GET command syntax is

> **The LaserJet macros used in PCBOOK are created by HP macro-control commands.**

```
GET #Filenum, Position& , Buffer$
```

Filenum is the BASIC file number with which the text file was opened. The Position is set using the PtrArray&() element that contains the starting point for the page needed. The Buffer$ is a string padded to the length of the page. For example, the current left side Buffer$ is padded with spaces using the basic statement:

```
Buffer$ =
 Space$(PtrArray&(LeftSide%+1)
 - PtrArray&(LeftSide%))
```

As we saw when we built the PtrArray&, the values in each element represent page breaks, so by subtracting the next-higher page from the one we need, we get the length of the page. The variables LeftSide% and RightSide% track the current portion of the page to be printed, while BookMark% tracks the number of sheets left to print.

When a form feed (CHR$(12)) is found in the text and recorded as a page break in the BuildArray module, the actual form feed character is counted in the page length. As the page is printed, the form feed must be removed, in order to keep the correct sheet order. An INSTR scan is done on the current Buffer$ to search for a CHR$(12), and if found, the string is printed only up to that character; otherwise the whole buffer string is printed.

PCBOOK reads the pages to print in the order of printing, not necessarily in sequential order, by using BASIC's GET statement with the position specified by PtrArray&().

After printing the left and right sides of each sheet, PCBOOK issues a form feed character. The program prints a text file in two passes, each pass printing one half of the pages. As each page is printed, the variables LeftSide%, RightSide%, and BookMark% are updated. Leftside% is decreased by 2 and RightSide% is increased by 2 because we are printing every other page on each pass. BookMark% is reduced by 1 each time, to track the number of physical sheets being printed. When BookMark% reaches 0, it signals the end of the pass.

The flag FirstPass% was set to a −1 at the start of the program, and it is now tested. If FirstPass% is true (−1) then PCBOOK prompts the user to reload the printed sheets and press Enter. The INKEY$ do/loop allows only two choices, Enter and Esc. By giving you only two ways to continue printing, the program eliminates the possibility that an accidental keypress will cause PCBOOK to resume printing before the sheets have been reloaded. The Esc key may be selected to cancel any further printing and end the program.

Assuming the user selects Enter to continue, the FirstPass% flag gets set to the value 0 and the program loops back to the DoPass label. At the end of the second pass, since the flag FirstPass% was cleared before, PCBOOK prints the message "Printing Done" to the screen and exits. On exit, an ESC$;"E"; resets the LaserJet, and BASIC's CLOSE statement closes all files.

Error trapping in PCBOOK is minimal but sufficient to avoid "Abort, Retry, Fail" messages from the operating system. If the printer is off-line or the power is off, BASIC issues an error 24 or 25. Running out of paper will cause the program to return an error 27. Almost any other error will be reported by number, and if applicable, with the device name with which the error occurred. ■

Jay Munro is a staff programmer and graphic artist at Crescent Software.

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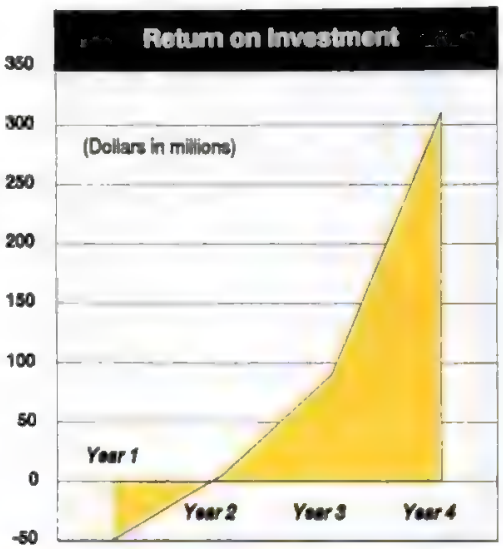

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Recently, *PC Magazine* placed Microsoft Excel version 2.10 head to head with Lotus 1-2-3 release 2.2 and 3. They measured the essential criteria by which spreadsheets are judged. As you can see from the chart, Microsoft Excel proved to be superior in its balance of capabilities. Further evidence of the advantages of the graphical-based Microsoft Excel over the character-based Lotus 1-2-3 can be seen in a recent study.

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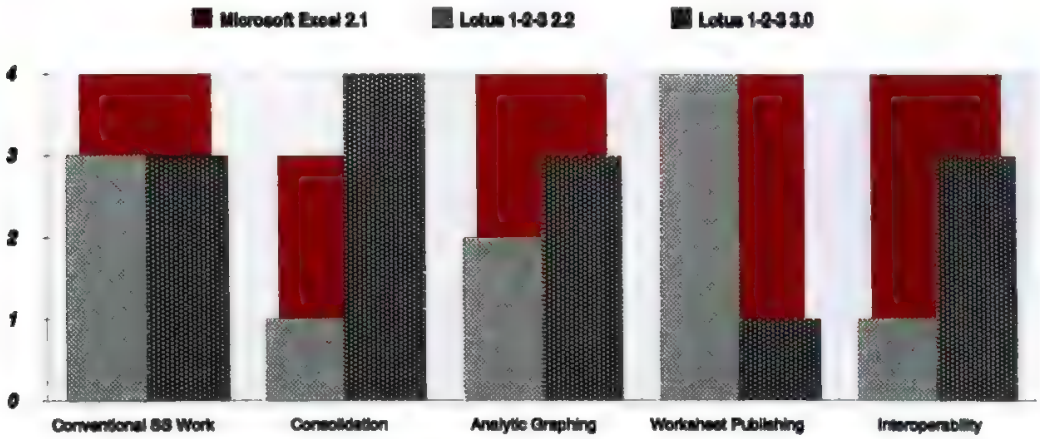

In this chart, PC Magazine** compares the salient spreadsheet criteria of Microsoft Excel and Lotus 1-2-3. As you can see, Microsoft Excel showed its superiority.

(Incidentally, this report was created using Microsoft Excel linked with Microsoft Word for Windows.)

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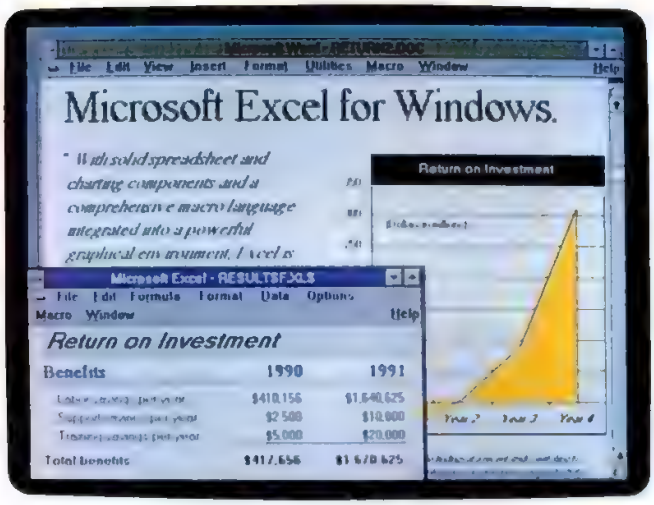

Windows can display Microsoft Excel and Word for Windows at the same time so you can see how all elements of your analysis will go together.

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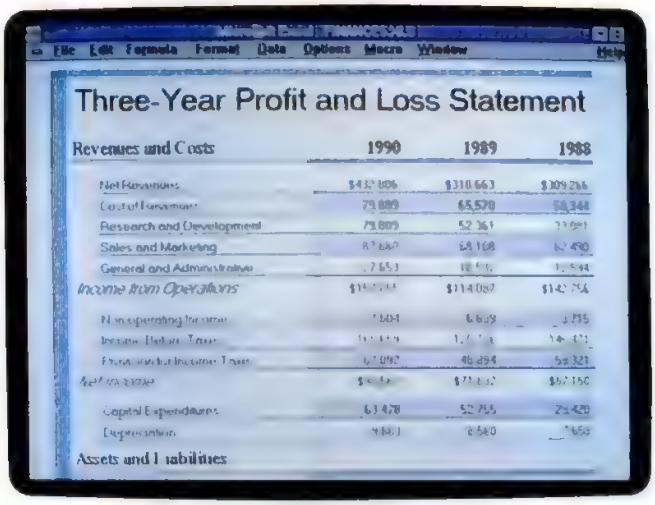

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by
Charles Petzold

Environments

Working with Metafiles: Modifying and Sharing Vector-Oriented Images

In the last issue, I discussed the support of metafiles under the OS/2 Graphics Programming Interface (GPI). A metafile is a collection of drawing commands encoded in a binary form. The metafile can be "played back" to render these drawing commands on an output device such as a video display or a printer. In structure and content, a metafile is quite different from a bitmap, which is a pixel-by-pixel representation of an image.

The bitmap and the metafile are the two standard forms of stored graphics data supported under the OS/2 Presentation Manager. You use metafiles for vector images defined by lines, filled areas, and text; you use bitmaps for raster images, which can originate from the real world through a scanner or a video frame grabber.

Both bitmaps and metafiles can be stored in memory or as disk files. In the last issue, I demonstrated how to use GpiSaveMetaFile to save a metafile to a disk file and GpiLoadMetaFile to load a disk-based metafile into memory. (Comparable functions for bitmaps do not exist in GPI; a future installment of Environments will show you how to accomplish these tasks.) This means that one program can create a metafile and store it on-disk and another program will be able to use it.

Both bitmaps and metafiles can also be shared among Presentation Manager applications through the clipboard.

METAFILES AND THE CLIPBOARD

Transferring metafiles between a Presentation Manager program and the Clipboard is a very easy operation. To see an example of this, you can modify the METAFILE program from the last issue of Environments. Replace ClientWndProc in METAFILE.C with the window procedure that is shown in Figure 1. You'll also need to include the line

```
$define INCL_WIN
```

in METAFILE.C before the line that includes the OS2.H header file.

> ■ GPI's rich support of transforms is one of its distinguishing characteristics, providing a powerful tool for manipulating metafile images.

This new version of the METAFILE program creates the metafile while processing the WM_CREATE message and then moves it into the clipboard using WinSetClipbrdData:

```
WinSetClipbrdData (hab, (ULONG)
 hmf, CF_METAFILE, CFI_HANDLE) ;
```

The second parameter is simply the handle to the metafile cast to an unsigned long integer. The last two parameters indicate that the data being set in the clipboard is a metafile, which is specified by its handle.

During the WM_PAINT message, the program obtains the handle to the metafile stored in the clipboard:

```
hmf = (HMF) WinQueryClipbrdData
 (hab, CF_METAFILE) ;
```

Of course, if the contents of the clipboard change between the WM_CREATE message and any subsequent WM_PAINT message, this will not work.

The usual rules about the clipboard apply to metafiles: After the WinSetClipbrdData call, your program no longer owns the object it has moved to the Clipboard. Do not attempt to use the handle after this call. And, when your program is obtaining an object from the Clipboard, it owns the object only between the WinQueryClipbrdData and WinCloseClipbrd functions.

If you want to continue using the object after moving it to the clipboard, make a copy of it first. In the case of a metafile, this is trivial:

```
hmfCopy = GpiCopyMetaFile (hmf) ;
```

Use one of the handles with WinSetClipbrdData and keep the other for your program to use. Similarly, when getting a metafile from the clipboard, make a copy of it before calling WinCloseClipbrd. Your program will own the copy.

HOW LARGE IS THE IMAGE?

Metafiles provide a convenient way for Presentation Manager programs to share and exchange vector-oriented graphical images, but there are some complications involved.

Suppose you're writing a PM word processing program. Text-only word processors are hopelessly passé, of course, so you want to give the user the option of including graphical images along with the text. These graphics could be either bitmaps or metafiles, and they could either be loaded from files or copied from the clipboard. You also want to give the user the option to move or resize the image. To do this intelligently, your program needs to know the size of the bitmap or metafile image.

For a bitmap, this is fairly easy. Your

program calls GpiQueryBitmapParameters to copy information about the bitmap into a BITMAPINFOHEADER structure. The cx and cy fields of this structure indicate the width and height of the bitmap in pixels. To display the bitmap in different sizes, you just pass the appropriate parameters defining the destination rectangle to the GpiWCBitBlt function.

There are no directly comparable functions in GPI for working with metafiles. However, obtaining information about the size of the metafile and actually changing its size aren't as bad as you might initially think (as I'll demonstrate in the next issue).

Indeed, once we start exploring this topic, a whole world of metafile manipulation opens up. You can display a metafile at its original size, stretch or compress it without the distortion associated with stretching or compressing bitmaps, and even rotate or shear the image. (Rotating bitmaps is something that GPI doesn't support at all.)

However, before we begin, you'll need to be familiar with the subject of GPI transforms.

GPI TRANSFORMS: AN OVERVIEW

A vector-oriented graphical image is defined by various graphics primitives, such as lines, filled areas, and text. The location of these primitives within the image is defined by coordinate points. By altering these coordinate points in a consistent manner, it is possible to alter the appearance of the image in some way. For example, if all the coordinate points were doubled, the image would be rendered twice as large.

As the word is used in computer graphics, a *transform* is a mathematical formula that modifies coordinate points. GPI's rich support of transforms is one of its distinguishing characteristics, as compared with other graphics programming systems. In this discussion, I'll restrict myself to the transforms available under the micro presentation space. (The subject becomes more complex when graphics segments—allowed in the normal presentation space—are introduced.)

When you call various GPI drawing functions such as GpiLine, GpiMove, and GpiBox, you pass coordinate points to the functions, specifying where the graphic is to appear. In many of the small Presentation Manager programs shown in previous installments of this column, these coordinate points have been in units of pixels relative to the lower-left corner of the program's client window. Thus, the client window corresponds to the upper-right quadrant of a normal Cartesian coordinate system, familiar to most high school graduates from a course in analytical geometry.

In reality, however, the coordinate points specified in the GPI drawing functions are subject to several hierarchical transforms, summarized by the diagram shown in Figure 2.

The coordinate points you pass to GPI functions are said to be points in *world coordinate* space. *World coordinate* is a traditional graphics term generally defined as "whatever coordinates are convenient for use by your application."

These world coordinates are modified by the model transform to produce points in model coordinate space. It is said that the model transform "maps" points in world space to points in model space. By default, this transform doesn't do anything and leaves the coordinate points as they were. (A transform that doesn't modify coordinates is called a *unity transform*.) You can set a nonunity model transform using GpiSetModelTransformMatrix.

Coordinates in model space are then modified by the default viewing transform to produce points on the presentation page. Normally, the default viewing transform doesn't do anything, but you can override that with a call to GpiSetDefaultViewMatrix.

Points on the presentation page are then modified by the device transform to map to device space—pixels relative to the lower-left corner of your program's window. The device transform is affected by the presentation page units and page size specified in the GpiCreatePS or GpiSetPS functions, and by the page viewport. Normally the page viewport is defined by GPI, but it can be altered by a call to GpiSetPageViewport.

It's tempting to attempt to visualize transforms graphically. However, this can prove to be very difficult. You'll acquire a

METACLIP.C COMPLETE LISTING

```
/*-----------------------------------------------------------------
   METACLIP.C -- Replacement ClientWndProc for METAFILE.C.
                 Demonstrates using the clipboard with metafiles.
                 (Remember to define INCL_WIN in METAFILE.C!)

                 (c) Ziff Communications Co, 1990
                 PC Magazine * Charles Petzold, 6/90
 -----------------------------------------------------------------*/

MRESULT EXPENTRY ClientWndProc (HWND hwnd, USHORT msg, MPARAM mp1, MPARAM mp2)
     {
     HMF hmf ;
     HPS hps ;

     switch (msg)
          {
          case WM_CREATE:
               hmf = CreateMetaFile () ;

               WinOpenClipbrd (hab) ;
               WinEmptyClipbrd (hab) ;
               WinSetClipbrdData (hab, (ULONG) hmf, CF_METAFILE, CFI_HANDLE) ;
               WinCloseClipbrd (hab) ;

               return 0 ;

          case WM_PAINT:
               hps = WinBeginPaint (hwnd, NULL, NULL) ;
               GpiErase (hps) ;

               WinOpenClipbrd (hab) ;
               hmf = (HMF) WinQueryClipbrdData (hab, CF_METAFILE) ;

               if (hmf != NULL)
                    GpiPlayMetaFile (hps, hmf, 0L, NULL, NULL, 0L, NULL) ;

               WinCloseClipbrd (hab) ;

               WinEndPaint (hps) ;
               return 0 ;
          }
     return WinDefWindowProc (hwnd, msg, mp1, mp2) ;
     }
```

Figure 1: Replace ClientWndProc in last issue's METAFILE.C program with this window procedure that demonstrates how to use metafiles with the clipboard.

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much better understanding working with the transform formulas.

MATRIX TRANSFORMS

Both the model transform and the default viewing transform are defined by three-by-three matrices, a very traditional concept in computer graphics. The PMGPI.H header file defines a structure named MATRIXLF for this matrix. The structure has nine fields, as shown below, that correspond to the nine cells of the matrix:

```
| fxM11   fxM12   lM13 = 0 |
| fxM21   fxM22   lM23 = 0 |
| lM31    lM32    lM33 = 1 |
```

The fx prefix on four of these structure fields indicates that the numbers are in the 32-bit FIXED format—the upper 16-bits are an integer part and the lower 16-bits are a fractional part. The l prefix on the other fields indicates these are LONG (32-bit signed long integer) values. The last column of the matrix is always initialized with 0, 0, and 1.

A point in two-dimensional world coordinate space can be represented by

(x_w, y_w)

or as a one-by-three matrix like this:

$| x_w \quad y_w \quad 1 |$

(Don't worry about the extra 1 at the end—it just makes some multiplications come out right.) When GPI applies the model transform to this coordinate point, it multiplies the one-by-three matrix by the three-by-three model transform matrix. This results in a one-by-three matrix representing the point in model coordinate space:

$| x_m \quad y_m \quad 1 |$

which is the point

(x_m, y_m)

If you've forgotten your matrix multiplication, the following formulas summarize the process:

$$x_m = x_w\ (fxM11) + y_w\ (fxM21) + lM31$$
$$y_m = x_w\ (fxM12) + y_w\ (fxM22) + lM32$$

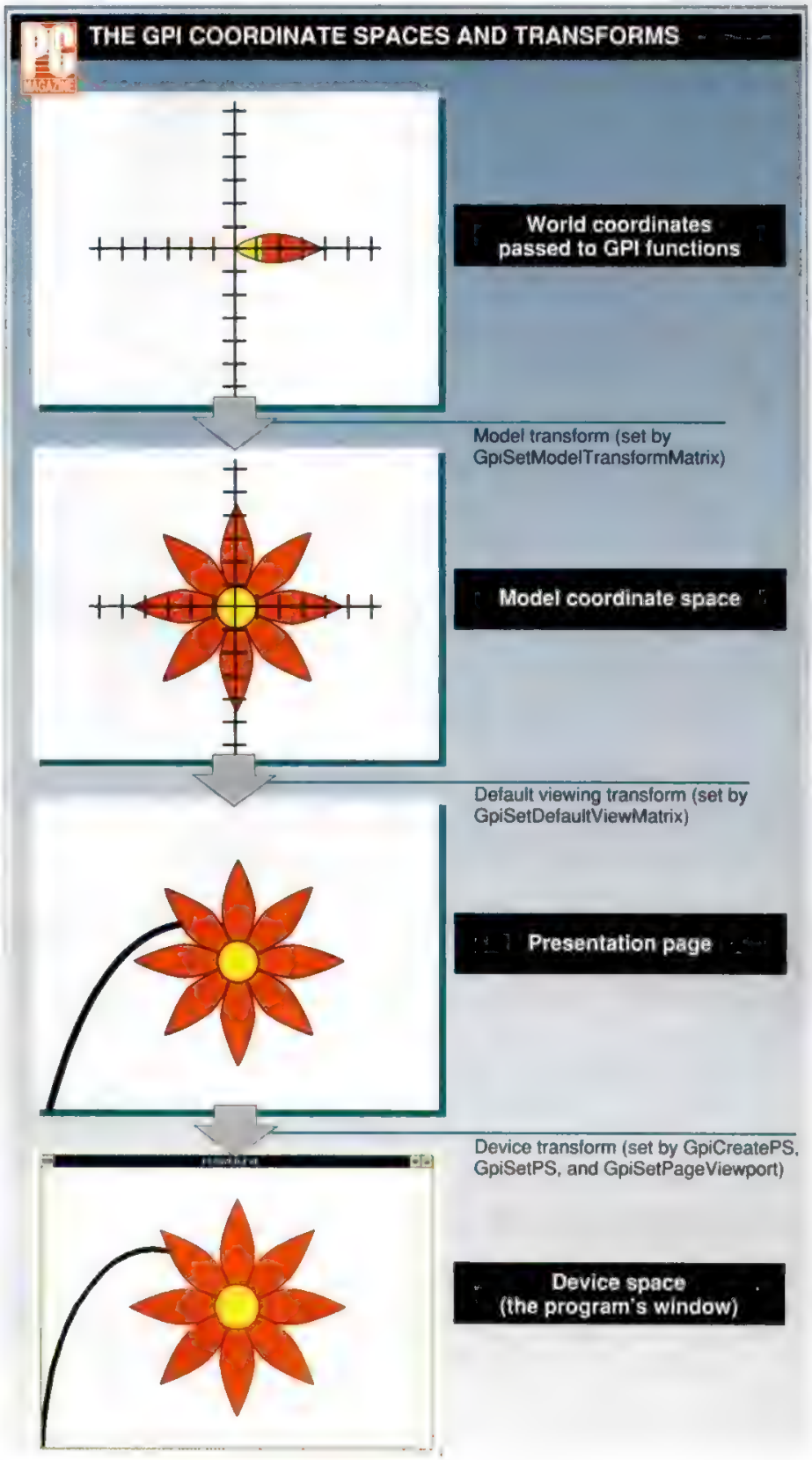

Figure 2: This diagram shows that coordinate points specified in the GPI drawing functions are subject to several hierarchical transforms.

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These are called *linear* transforms, because x_m and y_m are based on x_w, j_w and a constant rather than powers of x_w and y_w.

By default, the fxM11 and fxM22 fields of the model transform matrix are set to 1 (or to state this more precisely, they are set to the FIXED value 0x10000 representing 1.0), and the fxM21, fxM12, lM31, and lM32 fields are set to 0, which yields the following:

$$x_m = x_w$$
$$y_m = y_w$$

Thus, by default, the model transform does not alter the coordinate points. But if, for example, you use GpiSetModelTransformMatrix to set the fxM11 field to 2.0 (the FIXED value 0x20000), then you get the following:

$$x_m = x_w\ (2)$$
$$y_m = y_w$$

At this point, everything you draw using GPI functions will be twice as wide as the coordinates would seem to indicate. This type of transform is called *scaling*.

If you set the lM31 and lM32 values to something other than 0, you effectively move the origin of the coordinate space. This type of transform is known as *translation*. A world coordinate point of (0,0) passed to a GPI drawing function will actually appear at the point (lM31,lM32) in model coordinate space.

Let's suppose that you want to rotate the image counterclockwise by the angle α. In this case you would have to set the four fields of the transform matrix in the following manner:

```
fxM11 = (FIXED) (65536 * cos (α))
fxM21 = (FIXED) (65536 * -sin (α))
fxM12 = (FIXED) (65536 * sin (α))
fxM22 = (FIXED) (65536 * cos (α))
```

I've been discussing this transform matrix as it applies to the model transform. The default viewing transform is the same, except that it transforms points in model space:

$$(x_m, y_m)$$

to points on the presentation page:

$$(x_p, y_p)$$

using the formulas

$$x_p = x_m\ (fxM11) + y_m\ (fxM21) + lM31$$
$$y_p = x_m\ (fxM12) + y_m\ (fxM22) + lM32$$

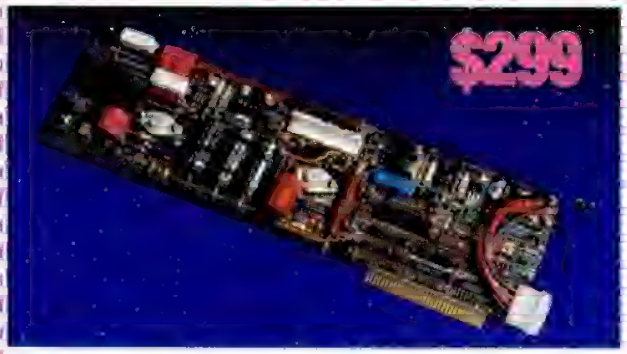
where fxM11 (and so forth) are the fields of the transform matrix you set using the GpiSetDefaultViewMatrix function.

Coordinates passed to GPI functions undergo two matrix transforms before the device transform. Why two? The reason (one reason, anyway) will be disclosed shortly.

THE DEVICE TRANSFORM

The third transform in the hierarchy is the device transform. This transform maps points on the presentation page:

$$(x_p, y_p)$$



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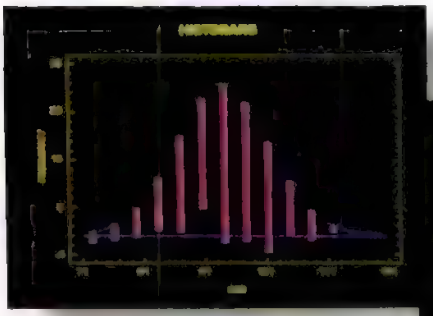

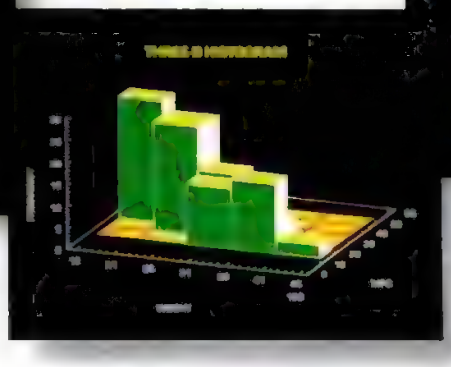

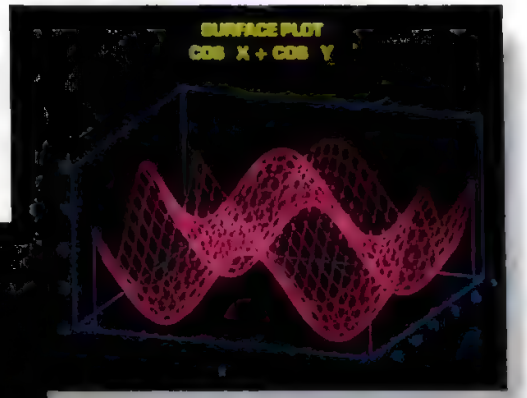

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to points in device space:

(x_d, y_d)

which are simply pixels that are relative to the lower-left corner of the program's window, with values of x increasing to the right and values of y increasing to the top.

When you obtain a cached micro presentation space by calling WinGetPS (as many small PM programs do), GPI sets the device transform so that points on the presentation page map directly to device space with no alteration. This, together with the two default unity matrix transforms, is what allows these programs to draw in units of pixels.

You can create a presentation space with a nonunity device transform by calling GpiCreatePS or—if the presentation space already exists—by calling GpiSetPS. In either case, the device transform is defined by the presentation page units you specify using one of the parameters beginning with the prefix PU, such as PU_LOENGLISH or PU_HIMETRIC. You also specify a size of the presentation page using a SIZEL structure. The size of the presentation page is in presentation page units.

When you define presentation page size and units, GPI defines a page viewport for you. The page viewport is expressable as a rectangle structure of type RECTL. The physical size of the page viewport rectangle in device units (pixels) is equal to the physical size of the presentation page in presentation page units. The four corners of the presentation page map to the four corners of the page viewport. This transform allows you to draw in units of millimeters or fractions of an inch.

If sizl is a SIZEL structure defining the size of the presentation page, and rcl is a RECTL structure defining the page viewport rectangle, then the device transform can be represented as follows:

$$x_d = x_p \frac{\text{rcl.xRight} - \text{rcl.xLeft}}{\text{sizl.cx}} + \text{rcl.xLeft}$$

$$y_d = y_p \frac{\text{rcl.yTop} - \text{rcl.yBottom}}{\text{sizl.cy}} + \text{rcl.yBottom}$$

When defining the page viewport rectangle, GPI sets the xLeft and yBottom fields to zero. Thus, the device transform reduces to simply a scaling factor applied to presentation page coordinates:

$$x_d = x_p \frac{\text{rcl.xRight}}{\text{sizl.cx}}$$

$$y_d = y_p \frac{\text{rcl.yTop}}{\text{sizl.cy}}$$

However, a program can alter the page viewport rectangle by a call to GpiSetPageViewport.

TRANSFORMS AND METAFILES

Now let's examine how metafiles deal with these three transforms.

In the last issue, I described how a metafile is created. A program opens a metafile device context by calling DevOpenDC with an OD_METAFILE parameter. The program then creates a presentation space associated with this device context by calling GpiCreatePS. The metafile consists of the GPI functions called using this presentation space handle. DevCloseDC returns a handle to the metafile. The metafile contains various records that define the graphical image stored within it. A program can render this metafile on an output device by calling GpiPlayMetaFile.

> The metafile contains various records that define the graphical image stored within it. A program can then render this metafile on an output device by calling GpiPlayMetaFile.

Above I discussed five functions that affect the three transforms applicable in the micro presentation space. Here's how these functions affect the metafile:

- GpiCreatePS: The page units, page size, and page viewport are stored in the metafile in the Graphics Data Descriptor record. However, by default, this information is not used when the metafile is played. Instead, GPI uses the device transform set for the presentation space on which the metafile is being rendered.

In last issue's METAFILE program, the metafile was created with page units of PU_LOENGLISH. When the metafile was played, the image was rendered in units of pixels. It was necessary to define a nondefault play option

```
alPlayOptions [PMF_RESET] =
 RES_RESET ;
```

and pass this array to the GpiPlayMetafile function. This option causes the destination presentation space to be reset using the page units and page size stored in the metafile.

- GpiSetPS: This function is not valid when used on a presentation space associated with a metafile device context. Don't use it when creating a metafile. You can use this function on a destination presentation space before playing a metafile, but if you also set the reset option (as shown above), GPI will use the page units and page size defined in the metafile.
- GpiSetPageViewport: The page viewport is stored in the Graphics Data Descriptor record of the metafile. However, it is ignored when the metafile is played. If the reset option is used, then GPI will calculate a page viewport based on the presentation page units and page size stored in the metafile and on the resolution of the output device on which the metafile is being played. Hence, do not use this function when creating a metafile.
- GpiSetDefaultViewMatrix: This transform is stored in the Graphics Data Descriptor record. When creating a metafile, you should call this function only once, and before you call any drawing functions. By default, this transform is not used when the metafile is played. GPI uses the default viewing transform set for the destination presentation space instead.

However, if you use the reset option (shown above) when playing the metafile, then GPI will use the default viewing matrix stored in the metafile.

- GpiSetModelTransformMatrix: All model transforms are stored in the Graphics Data records in the metafile, along with the other GPI drawing and attribute functions. You may use this function at will

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when creating the metafile, and it will always be used when playing the metafile.

Aha! This is the reason—or, as I have already mentioned, one of the reasons—for GPI supporting two separate matrix transforms: GPI always uses any model transforms stored in the metafile, but use of the default viewing transform is the program's option.

You need to use the model transform for assembling the various components of the picture. (A common example of this is some code that draws a wheel of a car. You have to use this code four times with four different model transforms when drawing the whole car.) Any default viewing transform you use should apply to the entire picture. If this picture is stored in a metafile, then the code that plays the metafile has the option of using the default viewing transform that is stored in the metafile or overriding it.

In short, when you play the metafile, you have one of two choices that affect the GPI transforms. If you don't use the play options or you set the PMF_RESET field of the play options array like this:

```
alPlayOptions [PMF_RESET] =
 RES_DEFAULT ;
```

or like this:

```
alPlayOptions [PMF_RESET] =
 RES_NORESET ;
```

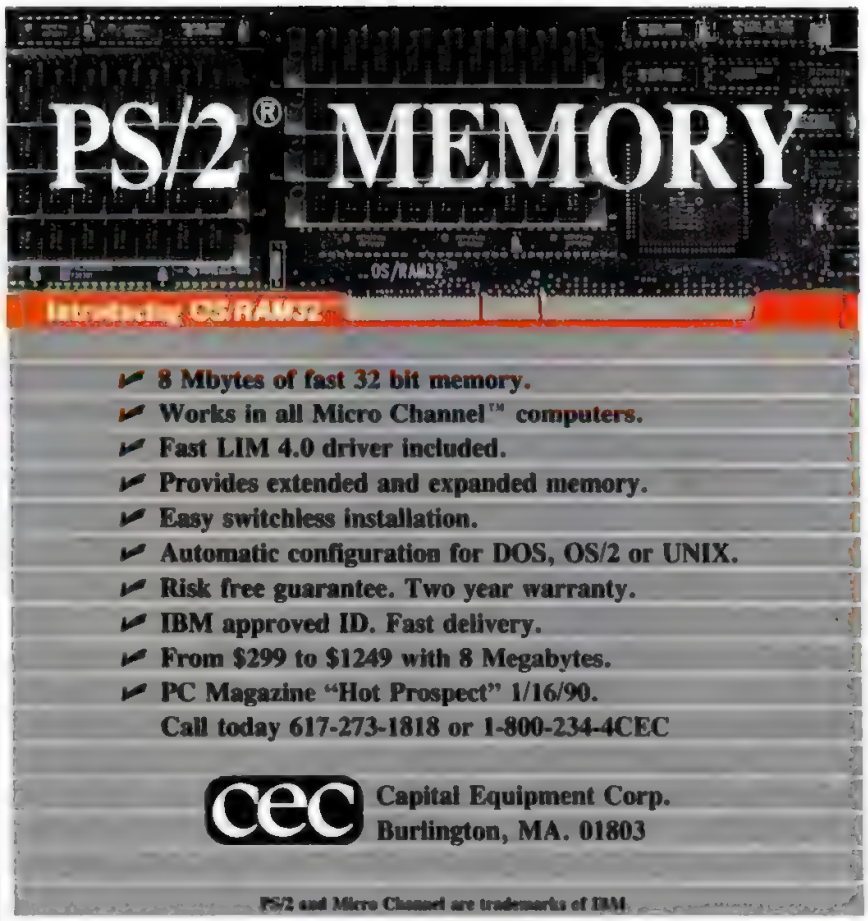
then the GPI uses the device transform and default viewing matrix currently in effect for the destination presentation space.

If you set the PMF_RESET field in the following manner:

```
alPlayOptions [PMF_RESET] =
 RES_RESET ;
```

then the GPI resets the destination presentation space using the presentation page units, page size (but not page viewport), and the default viewing matrix set when the metafile was created. The page viewport is set based on the resolution of the destination presentation space.

In the next issue, I'll show you how to obtain the size of the image in the metafile and the page units, page size, and default viewing matrix stored in the metafile. It's easier than you may think. ■



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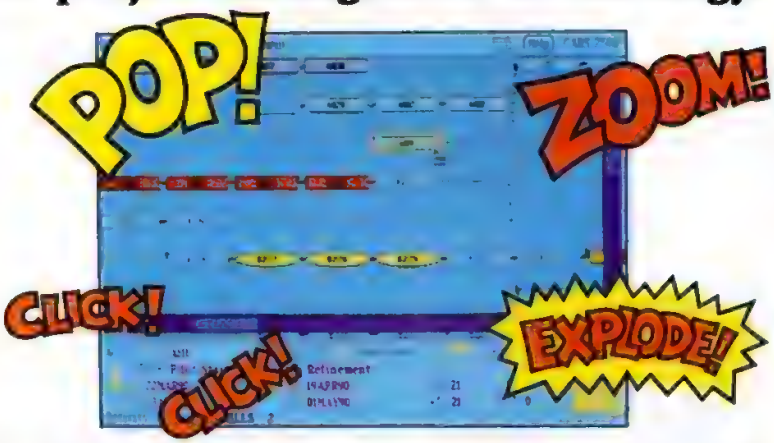

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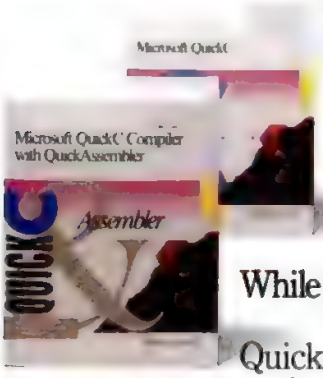

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by
Ray Duncan

Power Programming

The Successor to DOS: A Look at Several Possibilities

MS-DOS, Microsoft's venerable operating system for Intel 80x86-based PCs, was originally designed in 1980, and the last version of DOS to find widespread acceptance—Version 3.3—was released in 1987. In the meantime, sales of 80286, 80386, and 80486-based machines capable of running in protected mode have overtaken the sales of PCs based on the older, real-mode-only 8086s and 8088s, VGA video adapters have emerged as the standard, and RAM sizes of 2MB, 4MB, and even 8MB have become commonplace.

In other words, nearly all of us are running an operating system designed for teletypes, floppy disks, and a ten-year-old microprocessor on machines with high-resolution bitmapped color graphics, fixed disks, and the computing power of a small mainframe. Depending on whether you're inclined to view a cup as half empty or half full, we are either enduring an era of stagnation and decadence or entering a window of magnificent opportunity akin to the period that saw the sudden displacement of CP/M by DOS.

There are those who feel that the installed base of DOS is so large and the inertia of the user base so great, that we'll be stuck with DOS in essentially its present form forever. I'm not nearly so pessimistic. I believe that there is a huge, pent-up demand for more capabilities and that if a clearly superior, upward-compatible successor to DOS were to present itself, users would migrate to it in droves. But what form might such a successor take? Let's look first at the current pretenders to DOS 3.3's throne: the latest versions of DOS itself, the DOS clones, UNIX, and OS/2.

DOS 4.0 AND DOS 5.0

DOS 4.0, which was released in 1988, will probably merit a footnote in the history books as one of personal computing's major operating-system fiascos. The changes that appeared in PC-DOS 4.0 were entirely implemented by IBM, leaving Microsoft in the uncomfortable position of having to reverse-engineer the system in order to come up with a "generic" MS-DOS 4.0 that could be licensed to other OEMs. Moreover, DOS 4 proved to be typical of IBM's microcomputer software efforts in general. Remember *TopView*?

> ■ There's a huge, pent-up demand for a clearly superior, upward-compatible successor to DOS. But what form might such a successor take?

By the time DOS 4 had been in the field for a month, the bulletin boards and online services were swamped with messages about its many anomalies—also known as bugs. Aside from its lack of robustness, DOS 4 gave short shrift to another important virtue: compatibility. Many different classes of programs were broken by DOS 4, ranging from disk optimizers to network drivers. And the DOS 4 kernel had grown so fat that certain important applications wouldn't run, simply for lack of memory.

DOS 4 also had flaws in the area of usability. The much-ballyhooed "user-friendly DOS shell" was in fact a poor match for third-party products such as *PC Tools* or the *Norton Commander*. DOS 4's support for putting system tables and buffers into expanded memory, which received much admiring publicity in the honeymoon period after the system's initial release, turned out to be of marginal value. And DOS 4 set new standards for software intolerance and bigotry—it wouldn't even recognize a fixed disk formatted with "generic" MS-DOS that didn't contain the three magic letters IBM in the boot sector!

Users stayed away from DOS 4 in droves, which led to an unprecedented situation: IBM was unable to follow its usual procedure and "de-support" DOS 3.3 after allowing a suitable interval for users to update. In fact, as I'm writing this in 1990, DOS 3.3 is *still* outselling DOS 4 by a significant margin. In part users were reacting appropriately to DOS 4's reputation for being big and unreliable. But I suspect they also shied away from DOS 4 as a gut reaction to all the hype that surrounded its release. Users instinctively recognized that DOS 4 was really just DOS 3.4 with a funny version number assigned for marketing purposes.

By 1990, Microsoft had awakened from its preoccupation with OS/2, realized that DOS was still a cash cow, wrested control of DOS's development back from Boca Raton, and deployed famous software guru Gordon Letwin to recoup the damage done to DOS's reputation by DOS 4. The normally reticent Letwin was even spotted on-line on BIX (*BYTE*'s counterpart to *PC Magazine*'s PC MagNet) soliciting suggestions about what to put into DOS and what to leave out. DOS 5.0 is just entering beta testing as this column is being written, and it may reach the end-user market around the time you are reading this.

Microsoft's plans for DOS 5.0 show that the software giant has learned some

valuable lessons. Unless things change dramatically during the beta testing period, DOS 5.0's impact on programmers will be minimal. There are no changes to the Int 21h application program interface, there are no new partition formats, and there are no new device driver considerations. All existing applications, disk utilities, and device drivers will continue to work without changes; this should be a relief, especially to the manufacturers and users of networks, unerasers, and disk optimizers—all of whom found their software nonfunctional after replacing DOS 3.*x* with DOS 4.

For the most part, the changes in DOS 5.0 are oriented toward better use of machine resources. Microsoft has finally realized that DOS cannot be allowed to grow without limit and steal memory away from applications, so the DOS 5.0 kernel has been shrunk, with the objective of making it the same size as DOS 3.3. To further minimize its footprint below 640K, DOS 5.0 can run from ROM or (in systems with extended memory) from the High Memory Area (HMA). The installation process has been made more forgiving; COMMAND .COM has been enhanced with several new features, including command-line history and recall; and the infamous DOS Shell has been overhauled to make it smaller and faster.

Most importantly, Microsoft has finally assumed responsibility for providing end-user support for DOS. A 900 number wired to a building full of technical support personnel has been established, and the DOS 5.0 upgrade will be available directly from Microsoft or through retail outlets. Microsoft's cavalier policy that support has to be obtained from OEMs, even though most of them never do more customization of DOS than to slap their name on the box, has been abandoned at last.

But DOS 5.0 is still the same old DOS at heart—still basically an 8086/88 operating system; still unable to take proper advantage of the 80386 and 80486 processors internally; still harboring a raft of undocumented functions that are vital to the proper execution of TSRs; still without clean, documented redirector hooks for networking or installable file systems; and still lacking an interrupt-driven communications device driver and an efficient video driver.

THE DOS CLONES

Although the cloning of DOS appeared to be a futile enterprise as recently as 5 years ago, there are now several companies making a reasonable living doing exactly that. Two of the firms, IGC (*VM/386*) and Software Link (*PC-MOS*), seem to be directing most of their marketing efforts at small multiuser applications, such as medical office accounting. Another two companies, Datalight and Digital Research, have targeted the ROMable DOS market, consisting largely of laptops and embedded systems.

When these DOS cloners stray out of their chosen ecological niches, though, they find themselves on shaky ground. Mainstream applications track the capabilities of Microsoft's DOS, and Microsoft and IBM can make changes in this "gold standard" at will. This forces the cloners' product cycles into lockstep with Microsoft. I'm still trying to figure out why Digital Research thought it clever to start shipping their DR DOS, Version 5.0, *before* Microsoft released MS-DOS, Version 5. That, to put the kindest possible interpretation on it, is misplaced self-confidence.

> When DOS cloners, such as Digital Research and Software Link, stray out of their chosen ecological niches, they find themselves on shaky ground.

It's difficult to look at the current DOS clone vendors and imagine any of them coming to our aid with the killer product that could supplant DOS. None of the companies have *all* of the necessary ingredients—technical excellence and depth, marketing savvy, and infinitely deep pockets—that would allow them to successfully confront Microsoft on its home ground. It's possible, of course, that a challenger could appear from a completely unexpected direction. In 1980 who could have imagined Microsoft—known at that time mainly for BASIC and *Multiplan*—as the dominant operating system company?

UNIX

Unix, which was originally written at Bell Labs, has reached its present popularity by a convoluted route. For the first decade or so of its existence, it was hideously expensive to license commercially but was virtually given away to universities for use in computer science departments. During this period, Unix grew enormously, proliferating into many similar but incompatible variants. Professors and graduate students used Unix as a convenient testbed for research projects and late-night hacking.

After AT&T's communications monopoly was dismantled, it started poking around in the closets and back rooms for other things to sell—and it discovered that not only did it own Unix lock, stock, and barrel, but that academia had already conveniently produced a whole generation of Unix True Believers.

Unix was designed as a multiuser, multitasking operating system for minicomputers with teletypes and dumb cathode-ray terminals. But Unix has changed with the times and has evolved into a credible platform for single-user workstations running graphically oriented applications. At the same time, PCs have finally become powerful enough to run Unix and its applications at something better than the pace of a crippled snail. The current versions of Unix also have DOS-Merge capabilities, which allow them to run real-mode applications in a sort of DOS Compatibility Environment, as OS/2 does. These changes have pushed Unix sales into the ballpark of tens of thousands per month—an order of magnitude less than the Mac, and two orders of magnitude less than DOS, but no small potatoes nonetheless.

I don't consider myself a Unix expert, but I've spent a fair amount of time porting my own company's products to half a dozen different Unix implementations, and it's hard for me to conceive of Unix as a replacement for DOS. Despite years of attempts to make Unix more friendly and forgiving, it's still laden with literally megabytes of baggage that betray its fundamental nature: the penultimate C hacker's programming platform. The one implementation of Unix I've seen that could indeed be installed, comprehended, networked, and used successfully by normal mortals—the one supplied with Steve

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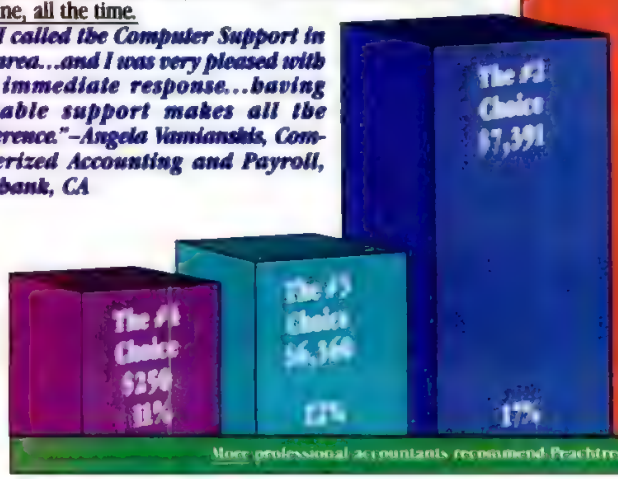

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PCM

Jobs' NeXT Machine—has thus far met with indifferent success.

Even if we were to back a long shot and choose Unix as the successor to DOS, which Unix and GUI are we talking about? System V, OSF, BSD, Mach, AIX, Motif, OpenLook, X, or NextStep? Not to mention the Unix clones such as QNX and Coherent, and Richard Stallman's semi-shareware GNU? Betting on the wrong horse could be economically lethal, because the much-anticipated binary and source code compatibility across Unix systems that was promised several years ago still hasn't materialized in any useful form.

OS/2

OS/2 as it exists today is a vastly different system than the protected-mode successor to DOS first envisioned by Microsoft in 1984 and 1985. The earliest version, internally known at Microsoft as DOS 5.0 or 286DOS, was small and relatively fast—it could even be booted from a floppy disk on a 1MB 80286 machine. The 286DOS application program interface (API), which was a proper superset of the DOS Int 21h, Microsoft Mouse Int 33h, and ROM BIOS video Int 10h and keyboard Int 16h interfaces, was small enough to be easily understood and allowed the straightforward porting of any DOS application. 286DOS was not burdened with a built-in graphical user interface; the original plan was to make a protected-mode version of *Microsoft Windows* available as a separate product that the user could run on top of 286DOS as an option.

But somewhere along the tortuous path from the original, experimental implementations of 286DOS to the retail product now known as OS/2, things went badly awry. A system designed to provide users and programmers with a painless migration path from DOS was transformed into a system designed to sell hardware and compete with Unix. Microsoft gave up its total control of OS/2's architecture when it entered into a Joint Development Agreement (JDA) with IBM, and this unholy alliance had many unfortunate consequences for both programmers and users.

First, some marketing decisions were made that seemed silly at the time and appear, in retrospect, incredibly stupid as well. At the last possible moment before its release to software developers, 286DOS was renamed OS/2, apparently for symmetry with IBM's new line of personal computers, PS/2s. This renaming alone caused endless confusion among journalists and users. The name OS/2 demonstrates no obvious lineage from DOS, and in fact is much more reminiscent of IBM's business-oriented minicomputers, such as the System/38, or IBM's traditional operating system behemoths for mainframes, such as OS/MVS or OS/360. Even now, more than three years after the original release of OS/2, there are still people who firmly believe that OS/2 will run only on PS/2 machines.

IBM's strategy of "phased release" of several OS/2 versions within a two-year time frame also kept users confused, requiring the frequent and painful installation of massive software updates.

> OS/2 as it exists today is a vastly different system than the protected-mode successor to DOS first imagined by Microsoft.

Second, the straight port of *Windows* to protected mode was abandoned in favor of a new, extremely complex, nonoptional graphical user interface known as the Presentation Manager, with an API that was vastly different from *Windows*'. The PM was largely designed at IBM in Hursley, England, the same IBM site that was responsible for IBM's Future Systems debacle in the 1970s. With the inclusion of PM, Microsoft's promises of source code portability and even binary portability from real-mode *Windows* to protected mode fell by the wayside, disk and RAM requirements for OS/2 shot up dramatically, and the possibility of booting a system from floppy disk or in a minimum nongraphical configuration no longer existed. Microsoft and IBM also failed to provide developers with appropriate graphically based programming environments for the Presentation Manager, instead offering only a character-mode-based editor, compiler, linker, and debugger, and a hodgepodge of C header files. Despite a lot of talk about object-oriented programming tools to make dealing with the hundreds of PM functions easier, nothing was ever delivered.

Third, Microsoft perplexed and dismayed the developer community by continually sending it mixed messages. Microsoft talked about stability and portability but changed the OS/2 API in every release, confronting developers with a moving target for their applications development. It lobbied developers to concentrate on graphical applications, but its own first OS/2 application was a perfunctory port of character-based *PC Word*.

Microsoft downplayed the importance of *Windows*, but developed three major new applications for *Windows* (*Word for Windows*, *PowerPoint*, *Project*) in the same timeframe as it released one somewhat lame PM-based product (*Excel*). It promoted CD-ROM continuously in its seminars and press releases, but couldn't seem to get an OS/2 CD-ROM device driver out the door. And Microsoft included the High Performance File System (HPFS) in OS/2 1.2 but then failed to follow through with an in-place file conversion aid or with reasonable backup programs. Microsoft also neglected to deliver usable printer drivers for nearly three years, obligating many pioneer OS/2 users to resort to DOS in order to generate hard copies of their spreadsheets or documents and crippling the end-user market for third-party OS/2 applications.

Fourth, when the 32-bit 80386 version of OS/2 finally arrived, Microsoft and IBM managed to confuse programmers and users yet again by not giving the new system a distinctive name and by public squabbling over the roles of Adobe PostScript, Apple's *TrueType*, AIX, NextStep, *Windows*, a mythical creature called PM Lite, OS/2 1.2, OS/2 1.3, and OS/2 2.0. They also managed to alienate many third-party developers by charging $2,600 for the 80386 software development kit—which initially consisted only of a handful of floppy disks and a few pages of printed documentation—making no allowances whatsoever for the pioneer developers who had invested time and energy in the 16-bit version of the system. Of course, in order to maintain a certain sort of consistency with past OS/2 releases, Microsoft and IBM were careful to drastically overhaul the 80386 OS/2 memory model, calling conventions, kernel API, and device driver interface in the name of some hoped-for future portability to RISC

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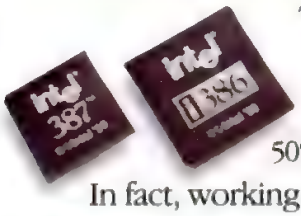

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processors, handing developers a host of new conversion problems to worry about.

It's clear to me that OS/2 is a technologically sound product, a fine platform for networking and graphical applications, and a reasonable alternative to Unix for high-end systems. But it's just as clear that it has gotten too big, too resource hungry, and too complex to play its original role as a drop-in replacement for DOS. If people really wanted or needed systems this elaborate on their desktop, Unix would already be there in the millions of copies.

> Today, there is not a proper successor to DOS, but Microsoft could create one with its existing technology.

THE SUCCESSOR TO DOS

In short, so far as I am concerned, the proper successor to DOS is not yet in evidence. On one hand we have gargantuan, multitasking operating systems that include everything imaginable but the kitchen sink and are massive overkill for normal desktop computing tasks. And on the other hand we have what are fundamentally 16-bit systems that can't take full advantage of the 386 and 486 processors and can only host 32-bit applications by means of DOS Extenders and other kludges. The astute reader will notice that I have thus far not dragged *Windows* 3.0 into this discussion. In the next installment, I'll describe the characteristics that I believe a successor to DOS should have and show how Microsoft could put together such a system with its existing technology.

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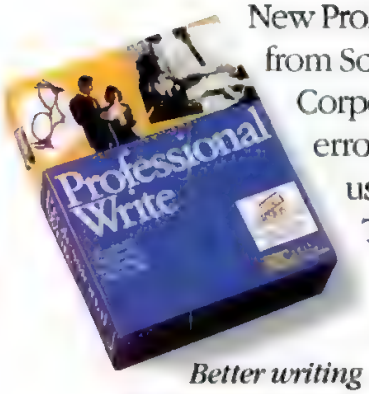

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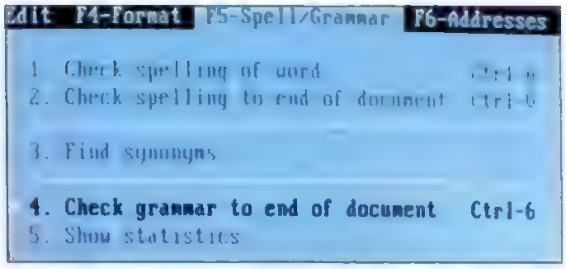

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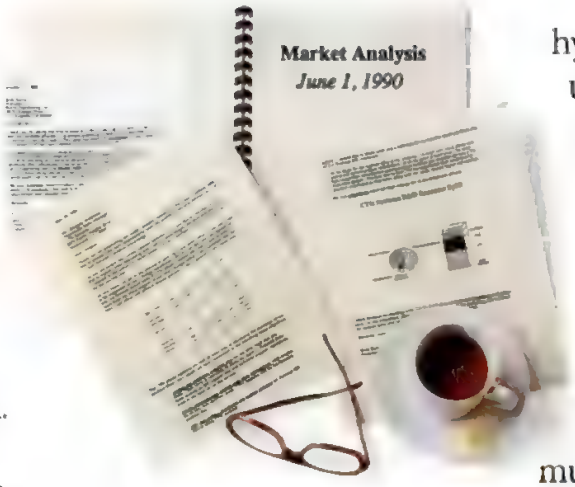

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General/Productivity/Utilities

Active Life (personal productivity) 149
Asymetrix Toolbook....309
BeckerTools for Windows....69
Distinct Back-up....119
Dragnet....127
File Manager (by Distinct) 83
hDC Windows Express....81
hDC Windows FirstApps 81
IBM Current....239
Master Tracks Pro for PCs 329
Microsoft Windows 3.0....95
OnTrak/The Information Organizer 169
PackRat 3.0....315
PackRat Network (3 User)....579
PackRat Network (additional User) 129
Palantir WinTime 169
Personal Librarian 849
PLUS for Windows (by Spinnaker)....395
PrintCACHE (by LaserTools) 129
Printer Control Panel (by LaserTools) 129
Prompt!....113
Publisher's Powerpak (by ATECH)....69
PubTech CBM Desktop Office....155
SmarText (by Samna)....call
SmartWin....69
The DeskTop Set 79
Windows/On The World 409
YourWay (by Prisma)....169

Publishing/Graphics

ABC Flowcharter (by Roykore)....249
Adobe Illustrator/Windows 299
Adobe Streamline/Windows 235
Aldus PageMaker 509
Arts & Letters Graphics Composer....309
Arts & Letters Graphics Editor 509
CA Cricket Graph....149
CA Cricket Presents....339
Corel DRAW!....325
DoDOT! (screen capture/convert) 109
Hammerlab ScanDO 149
(HP/Canon/Panasonic/Princeton/Ricoh)
IMAGE-IN....639
Image Prep (screen capture/convert)....159
Import for Windows (by Zenographics)....219
Micrografx Charisma....329
Micrografx Designer 3.0 469
Micrografx Draw Plus 189
Micrografx Xport ....call
OmniPage /386 719
OPUS-1 (by Roykore) 299
Palantir WinScan (for Microtek scanners) 79
PC Paintbrush Plus/Windows (by Z-Soft)....99
Photo Finish 1599
Picture Publisher 489
Pixie 2.0 (by Zenographics)....239
PowerPoint for Windows (Microsoft)....335
Publishers Type Foundry (by Z-Soft) 349
PubTech Multi-Tack 119
READPRO....489
Scrapbook+ 2.0 (by Eikon)....129
SoftType (by Z-Soft)....159
Springboard Publisher....99
Tiffany Plus (screen capture/conv)....79
Windows Color Lab I/P....489
(for Sharp, Microtek & Mitsubishi scanners)
ZING (by Enabling Technologies) 155

Word Processing

Ami' 129
Ami' Professional....319
Gram-mat-ik for Windows....89
NBI Legacy....359
Palantir Windows Spell 3.0....79
Palantir WinText 149
TextManager 2.0....95
Word for Windows (by Microsoft)....329

Database/Forms

Access SQL 1279
dBFast/Windows....295
ERwin (for Windows 3.x)....729
Horizon....179
INTEGRA SQL (by Coromandel)....609
JetForm....399
MARVIN Image Database....2395
Omnis Quartz....599
Palantir WinFiler....169
Q+E....125
SQL Windows (by Gupta) 1099
Superbase 2....219
Superbase 4....429
Thinx....399
Xerox FormBase....399

Financial/Accounting

Bookkeeping by Design 559
CCA Basic Small Business Package....295
CCA Enhanced Business Package....695
Client Write-Up by Design....1059
Excel for Windows (by Microsoft)....308
MacroCalc....109
MacInTax for Windows 73
TWINdows 249
Wingz (by Informix)....359

Engineering/Planning

CON-FLO, control valve analysis....179
Design/IDEF....2759
DesignView....749
DRAFIX Windows CAD....439
MetaDesign, diagramming tool 319
Micro Planner....489
Milestones, Etc (by Kidasa) 139
ORI-FLO, metering analysis 179
Project for Windows (Microsoft)....469
Project OUTLOOK 3.0....229
PUMP-FLO, pump analysis 179
RFFlow, flowcharting 109
Service Trak....689
SPACETEK:Facility Planner 4619
Topdown Project Planner (by Ajida) 249

Development Tools

ACTOR 3.0 609
Bridge 2.0 Tool Kit (for Windows 3) 629
Bridge 2.0 Runtime (for Windows 3) 125
C-TRIEVE/Windows (by Coromandel)....349
C_talk/Views 409
C++/Views....469
CASE:W 1.2 (by CASEworks) 675
CASE:W 3.0 (by CASEworks) 849
Eikon Resource Scrapbook 199
Eikon Standard Control Pak....call
Eikon Tools Control Pak ....call
Guide 3 (by Owl Int'l) 409
Guide Reader (by Owl Int'l)....call
Icon Author - Basic (by AimTech) 999
Icon Author - Full (by AimTech) 2249
Knowledge Pro Windows 629
Lasertalk PC 309
Level5 Expert System....609
Matesys ObjectScript 139
ProtoView....595
ProtoGen....409
Pubtech BatchWorks....89
The Whitewater Resource Toolkit....169
Whitewater Language Extensions 89
WinTrieve....335

Connectivity

Altos APEX 599
Altos MultiView....849
APE, A Programmable Emulator 159
Business Sessions for Windows....269
CrossTalk for Windows....119
DaVinci eMAIL for Windows 925
DaVinci eMAIL 8 user kit....335
DCA WindowLink for IRMA....329
DynaComm (Windows)....249
Faxit! for Windows 157
MicroPhone II....259
Network Courier 875
TERM for Windows....169
Windows Workstation....519
WinTerm....409

PM APPLICATIONS

Active Life (Personal Productivity)....149
Aldus PageMaker 519
CASE:PM for C (by CASEworks) 1895
CASE:PM for C++ (by CASEworks)....1895
CASE:PM for MicroFocus Cobol 2369
ChipChat (by Cawthon)....299
Corel Draw! ....call
DeScribe....519
Excel for PM (by Microsoft) 308
Lotus 1-2-3/G 549
Micrografx Designer 469
Nexpert Object, PM Runtime....919
Object-1/PM (by MDBS)....895
OS/2 PM Softset (by Microsoft)....119
OS/2 PM Toolkit (by Microsoft) 409
PackRat....315
PackRat Network (3 User)....579
PackRat Network (additional User) 129
Perspective OS/2 (by Three D Graphics)....249
RT-Graphics (by FSI) 929
RT-Graphics Toolkit w/source (by FSI) 649
Wingz (by Informix) 359

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by
William S. Hall

Windows

RUNNING PC TOOLS UNDER WINDOWS

I'm running *Windows/386*, Version 2.11, on an Everex 386SX under DOS 4.01. For the most part, I'm quite pleased with *Windows*. But when I run *PC Tools*, Version 5.5, *Windows* often hangs when *PC Tools* accesses the floppy disk drives. Is there a simple solution to this, other than running *PC Tools* directly from DOS?

Gregory J. Anderson
Portland, Oregon

Your problem may be related to the *PC Tools* utility that is able to copy high-density disks in a single pass using expanded memory as a buffer. Users have reported that some versions of *PC Tools* have problems with any source of expanded memory, not just *Windows/386*, after repeated copying of high-density disks. Central Point Software is aware of the problem, and you should call (503) 244-5782 for assistance.

PC Tools isn't the only DOS program with which you should exercise caution when running inside *Windows/386*. To find out why, read on.

MORE PROBLEM PROGRAMS

I found out the hard way that there are certain programs you're better off never running under *Windows*. CHKDSK is one example. The one time I ran it, it closed some files *Windows* was using and locked up my computer. To avoid this, I created a batch file to start *Windows* and prevent certain programs from executing when *Windows* is running. In the batch file, I created an environment variable with the line

```
set Windows=y
```

Then I renamed CHKDSK and created a batch file (shown in Figure 1) to run it. The batch file checks for this variable and will not execute the renamed CHKDSK program if *Windows* is active.

Gary Keuver
St. Louis, Missouri

- **RUNNING PC TOOLS UNDER WINDOWS:** Some versions of *PC Tools* have problems with any source of expanded memory, not just *Windows/386*.
- **MORE PROBLEM PROGRAMS:** Certain types of DOS programs shouldn't be executed from within *Windows*.
- **LARGE DISK PROBLEMS:** Using third-party disk partitioning software is risky in *Windows* 3.0 enhanced mode.

The best defense is a good offense. Ever since its early days, Microsoft has cautioned against using CHKDSK from within *Windows*. More recently, it has softened a bit. In *Windows* 3.0, it only cautions against using CHKDSK with the /F switch. Without the /F switch, CHKDSK works fine.

CHKDSK/F can modify the FAT. Other programs that perform similar operations also don't run properly with *Windows* and can cause you to lose data. These include the following:

- Third-party disk-caching programs. If you need a disk cache, use SMARTDrive, which is included with *Windows*. This utility is not confined to *Windows*.
- Hard disk optimizing programs. These include *The Norton Utilities'* Speed Disk, *PC Tools'* Compress, and Golden Bow Systems' *Vopt*.
- Hard disk utilities: These include *The Norton Utilities'* NU.EXE or *PC Tools Deluxe*. These programs can be used safely as long as you don't use a utility that modifies the hard disk.
- The DOS FORMAT command, if applied to a hard disk.
- Hard disk test and repair utilities such as *The Norton Utilities'* Disk TEST or *Mace Utilities'* REMEDY.
- Disk backup utilities such as *Fastback* or *COREfast*.

Note: You can use these programs and commands without risk once you exit *Windows*.

CHKDSK.BAT COMPLETE LISTING

```
@ECHO OFF
IF NOT '%WINDOWS%' == 'y' GOTO ok
ECHO Can't run CHKDSK under windows!
GOTO end
:ok
REM Assumes you renamed CHKDSK to CDSK
CDSK
:end
```

Figure 1: This batch file checks to see if *Windows* is active and won't run CHKDSK if it is.

LARGE DISK PROBLEMS

My system has a 320MB (approximate formatted capacity) hard disk drive with an ESDI controller. I wanted to set it up so that the system would recognize the entire hard disk. Performing a low-level format in translation mode specifying 618 cylinders, 16 heads, and 63 sectors per track seemed to do it. These values do not agree with the actual specifications of the drive. But it seemed to work, so I continued and, using DOS 4.1, I specified one partition.

At times, after a read or write, the disk would pause—sometimes for as long as 45 seconds. So I tried a primary partition of 42MB and an extended partition of 280MB, which I broke down into two logical drives. This didn't solve my problem. But I noticed that the problem seems to occur only when I run *Windows/386*. I've tried setting virtualHDirq=off in WIN.INI under the [Win386] section, but it doesn't solve the problem. Am I doomed to continual "walkabouts" on an otherwise fast machine?

David Johnson
Cary, North Carolina

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Windows

Problems with large hard disks when running *Windows/386* or *Windows* 3.0 in enhanced mode is one of the hot topics on several bulletin boards. And it's a particularly frustrating problem.

First, I suggest you try partitioning your drive using FDISK into the classic maximum sizes of 32MB or less. At one time, I was using a disk of over 300MB on an Olivetti 386 machine and experienced no particular problems with *Windows/386* under DOS 3.3. The disk was divided into a boot partition of 32MB and the remaining logical partition had nine drives of 32MB or less. If this doesn't solve your problem, you might want to try your luck with *Windows* 3.0. It's a well known fact that *Windows/386*, even in the latest version (2.11), has a few bugs.

To find out whether or not you can use *Windows* 3.0 on your system, call the *Windows* hotline at (800) 323-3577; if you have already purchased it, you should consult the "*Windows* 3.0 Hardware Compatibility List" which is included in the retail package. If you have the standard hard-disk-and-controller configuration of one of the computers that appears on this list, you'll be able to run it.

You shouldn't experience difficulties with any type of disk/controller combination running *Windows* 3.0 in real and standard modes. Difficulties here point to hardware problems. However, in enhanced mode, *Windows* 3.0 supports only standard ST506 or ESDI controllers. To use enhanced mode with SCSI or other nonstandard devices, load SMARTDrive. When enhanced mode detects SMARTDrive's presence, it directs all disk accesses through it. SMARTDrive thus functions as a double-buffered hard disk device driver, eliminating *most* compatibility problems.

You could still receive a message such as "Cannot Read(Write) from Drive X:" or "Drive X: Not Ready". If you do, make the following entry in your SYSTEM.INI file:

```
[386ENH]
VirtualHDIRQ=off
```

This entry allows the ROM routine that accesses the disk to function. It reduces performance, but that may be necessary if the controller or partitioning scheme is incompatible with *Windows'* virtual machine's direct disk access. This line is not case sensitive, and you can use synonyms for *off*, such as no, 0, and false. (In *Windows/386*, the section head is [WIN386]).

Remember, *Windows/386* and *Windows* 3.0 require you to partition your drive with FDISK. Using third-party partitioning utilities may have some deleterious effects, as we've just recently learned. At the time of this writing, Microsoft has just identified conflicts between SMARTDrive and some third-party disk-partitioning software that can result in the loss or corruption of data. (*Windows* 3.0 is fully functional without the optional disk caching utility). Your system *is* at risk if

- you are using third-party disk partitioning software, like the ones that are listed below, *and*
- a hard disk on your system has more than 1,024 cylinders, *and*
- you are using *Microsoft Windows'* SMARTDrive disk-caching utility.

This scenario occurs only if you're running third-party disk-partitioning software. Since the DOS FDISK partitioning software does not support disks with more than 1,024 cylinders, neither does *Windows*. Some disk controllers attempt to translate a hard disk with more than 1,024 cylinders into a logical disk with less than 1,024. As a result, they don't provide 100 percent compatibility in this area.

Your system *might* be at risk if

- you are using third-party disk partitioning software like that listed below, *and*
- your system contains a hard disk whose type is not directly supported by the system's ROM BIOS, *and*
- you are using *Microsoft Windows'* SMARTDrive, *and*
- you are currently using DOS, Version 3.30 or later.

The probability of risk is greater if your system was customized with off-the-shelf parts. Name-brand computers ship with ROM BIOS versions that support the hard drives installed by the manufacturer.

To determine if your system is at risk, review the list below of known disk-partitioning systems that, when used in conjunction with SMARTDrive, pose a threat. Then open your CONFIG.SYS file with an ASCII text editor and look for the corresponding device= lines:

- *SpeedStor* from Storage Dimensions, indicated in CONFIG.SYS with either device=SSTOR.SYS or device=HARDRIVE.SYS.

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■ *InnerSpace* from Priam Systems, indicated in CONFIG.SYS with device=EDVR.SYS

■ *Vfeatures Deluxe* from Golden Bow Systems, indicated in CONFIG.SYS with device=FIXT_DRV.SYS.

■ *Disk Manager* from Ontrack Computer Systems, indicated in CONFIG.SYS with device=DMDRVR.BIN.

If you're using one of the first three packages and your system is at risk, you can either remove SMARTDrive or repartition your hard disk using the DOS FDISK utility instead of third-party disk-partitioning software.

To remove SMARTDrive from your system, with your CONFIG.SYS file open, delete the following line:

```
device=smartdrv.sys
```

Then all that you need to do is save the change and reboot.

If you're using *Disk Manager*, use the following procedure to determine whether your system is at risk. First, you need to determine whether you have a hard drive with more than 1,024 cylinders. At the DOS prompt, invoke *Disk Manager* in manual mode by typing DM /M. Then type C to display the disk configuration. If any of the disks displayed has an Actual Cylinder Count over 1,024, you're at risk when using SMARTDrive.

Next, you will need to determine whether your hard disk is supported in the system BIOS or not:

■ At the DOS prompt, type VER to display the version of DOS you are running. If it's earlier than 3.30, you're not at risk. Otherwise continue.

■ Invoke *Disk Manager* in manual mode by typing DM /M.

■ Type C to display the disk configuration.

■ If the display says Parameters Are Standard, you're not at risk. If it says Parameters Are Replaced, continue.

■ For each disk in your system, compare the Setup Parameters with the Actual Parameters displayed. If all of the disks displayed have a Setup Head Count that matches the Actual Head Count and a Setup Sector Count that matches the Actual Sector Count, you're okay. If you don't find a perfect match, your drive is referred to as "nonhomogeneous," and you will need to continue.

■ From the *Disk Manager* main menu, type S to select the nonhomogeneous drive.

■ Type P to see the partition table for this drive.

■ If the drive has a partition with the Type DOS *and* one or more Type Write-Read or Read-Only partitions, you are at risk.

■ Repeat the last three steps for each of the nonhomogeneous drives that are in your system.

If you have additional questions or problems that haven't been addressed here, you should contact Microsoft Product Support at (206) 454-2030.

OPENING WINDOWS

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edited by
Trudy Neuhaus

Databases

DATABASE INDEXING WITH BASIC

Can you give a crash course on indexing? I program primarily in BASIC, although I've dabbled in assembly.

Mike Sullivan
Davie, Florida

■ Explore database indexing with BASIC using sequential and random access, the two main methods of storing data.

An index is (usually) a separate file that contains a subset of the main data file. So for example, an index to a customer database might contain only the account numbers. Record 1 of the index file might be the same account number that's in the first record of the main data file, and so on. So an index file is usually smaller than its corresponding data file.

The purpose of an index file is to speed the process of locating information in a database. However, its ability to locate data depends on how the data is stored. There are two main methods for storing data from within a BASIC program: sequential and random access. (For the purposes of this article, BASIC refers to QuickBASIC and BASIC 7 Professional Development System.)

Sequential files are simply a collection of records stored sequentially; that is, the data is stored in the order that it is entered. Each record in a sequential file uses only as many bytes as it needs. While the economy of space may be appealing, sequential access is limited in that the length of every record is different and not always known. Without knowing the length of the records, it's not easy to calculate where a given record starts and ends. The result? Sequential files often force you to look at every record until you find the one you want. And thus, while using sequential files may save you space, it won't save you any time.

Furthermore, sequential files don't lend themselves to being updated. For example, let's suppose a client has moved and you need to update his record. More than likely, his new address will not be the exact same length as his old address. If it's shorter, you're in luck: you can pad it to the old length with null bytes or blank spaces. But if it happens to be any longer, there's no way to directly insert it into the same place. Rather, you have to add a new record and mark the old one for deletion. Then, periodically, you have to "pack" your database—that is, copy over only the nondeleted records. But who wants to do all that?

The second way to store data is by using a random access file. With this method, each field, and therefore each record, has a predetermined length. For example, 32 characters are often set aside for a name field, even though some of the names in the file may very well be shorter than that length. However, when you know the record number you are looking for and the length of each record, you can obtain its location by determining the byte offset into the file. Therefore, when you're searching for a particular (and known) record number, the information can be retrieved virtually instantly.

One purpose for which the sequential method works better is memo fields. Because of the complexity of memo fields, I won't go into great detail here on how they work. Suffice it to say that there's no way to know ahead of time how long each memo may be; indeed, a memo could require a very large number of bytes. One common storage-and-access method uses a long integer pointer field located in the main data file record. This field holds the location of the data in the file that stores just the memo information. As memos are deleted and updated, the new information is simply stored at the end of the memo file, and the pointers in the main file are updated. This requires cleaning up the memo file from time to time, purging the now-obsolete memo data.

Now, what happens when you don't know the record number? How can a database program possibly find the right record if you know only the *information* you want to view? If you ask to see the customer record for "Jones, Robert," for example, how can the program locate that particular record? One way, of course, would be for the program to load and examine each record until the correct one is found. This may be an acceptable approach for files that contain fewer than a couple hundred records *and* are stored on a hard disk. But when searching thousands of records, this approach will take a very long time (and defeat the purpose of storing data in a random access file in the first place). This is where indexing comes into the picture.

CREATING AN INDEX

A data file is indexed on its fields; that is, a record in an index file corresponds to a field in the main data file. Common data types in an index file are integer (2 bytes), long integer (4 bytes), single and double precision (4 and 8 bytes, respectively), and string (unlimited).

The smaller the index, the better: not only does this conserve disk space, but it results in faster searches. One way to reduce the size of an index is to keep only the first four or so characters of a string field in the index file, even though a string field can be nearly any length.

Of course, if only the first few characters are stored in an index, it is possible that a search will locate an incorrect record. (Usually indexing subroutines converts an index of names or addresses to all uppercase before storing them in the index file. This way, the appropriate capitalization will be remembered in the main file, and the user doesn't have to worry about it when doing a search.) For example, if you ask the program to find the name Smith, it will also find Smithson. However, it is simple for a program to do an additional, complete comparison before presenting

SEARCHING AN INDEX ARRAY IN QUICKBASIC

```
TYPE IType                          'define the index data type
   IndexData AS STRING * 4          'using a 4-byte string
END TYPE

TYPE RType                          'define the main record
   LastName AS STRING * 15          'show just the first few
   FirstName AS STRING * 10         '  data fields in this
   DatePaid AS STRING * 6           '  brief example
   BalanceDue AS DOUBLE
   .
   .
END TYPE
DIM SHARED RecData AS RType         'we'll load RecData with
                                    '  the primary record data

                                    'open the files for RANDOM
OPEN "MAIN.DAT" FOR RANDOM AS #1 LEN = LEN(RecData)
OPEN "NAME.NDX" FOR RANDOM AS #2 LEN = 4

NumRecords% = LOF(2) \ 4                'see how many records
DIM Index(1 TO NumRecords%) AS IType    'create an index array

FOR X% = 1 TO NumRecords%               'load the index record
    GET #2 , , Index(X%)                '  by record so we can
NEXT                                    '  search repeatedly
CLOSE #2                                '  later if needed

LINE INPUT "Name to search for: ", Search$   'prompt for name
Search$ = UCASE$(Search$)                    'convert to caps
                                             'try to find it
CALL FindMatch(Index(), Search$, NumRecords%, FoundAt%)

IF FoundAt% THEN                            'we found one
   PRINT "Found at record"; FoundAt%        'show where
   PRINT RecData.LastName                   'print each field
   PRINT RecData.FirstName                  '  in the record
   PRINT RecData.DatePaid
   PRINT RecData.BalanceDue
ELSE
   PRINT "Name not found!"                  'no such name was
END IF                                      '  found in index

CLOSE #1                                    'clean up and end
END

SUB FindMatch(Index() AS IType, Search$, NumRecs%, FoundAt%)

    Subset$ = LEFT$(Search$, 4)    'isolate first four chars.
    FoundAt% = 0                   'assume we won't find it

    FOR X% = 1 TO NumRecs%
        IF Index(X%).IndexData = Subset$ THEN 'possible match
           GET #1 , X%, RecData               'get the record
           IF INSTR(UCASE$(RecData.LastName), Search$) THEN
              FoundAt% = X%                   'it matches
              EXIT SUB                        'we're all done
           END IF
        END IF
    NEXT                                       'keep searching

END SUB
```

Figure 1: This QuickBASIC subprogram will search an entire index array for a match and return the element number of where it was found.

the record on the screen. It is also up to the database program to update the index file whenever new information is added or changed in the main data file.

You may want to access information quickly in more than one field—last name and zip code, for example. In this case you would simply maintain a separate index file for each additional field. When you ask the program to search for a given last name, it will load and examine the index file that contains only the last name portion of each record. It's important to note that if the program is going to read and examine each record in the index file, this will still take a certain amount of time. But there are ways to make even indexed searches happen faster.

Depending on how small your index file is, it may fit entirely in RAM. (A record in the main data file might be, say, 230 bytes long, while an account number stored as an integer in an index file will require only 2 bytes per entry.) Even if the entire file cannot be loaded into memory at one time, a substantial portion may fit. If so, all or most of the searching can be performed in memory, which is many times faster than repeatedly accessing the hard disk.

SEARCHING MEMORY IN BASIC

The features that are most handy when you do any database type of programming in BASIC are the READ and DATA statements, Random Access files with full support for network file locking, and the FIELD statement. FIELD makes it possible for you to access any type of data file on-the-fly. The example programs presented here do not take advantage of BASIC's FIELD capability. For simplicity, TYPE variables are used to define the structure of the data file.

The program fragment shown in Figure 1 will search an entire fixed-length string index array stored in memory in order to locate a match. Although this routine is designed to search for string data, you can easily modify it to work with any BASIC data type that you want. To index a dollar amount field, for example, simply modify the TYPE variable to contain a single- or double-precision component rather than a fixed-length string.

To illustrate the index searching in context, Figure 1 also shows how the TYPE data is defined and how the index data is sized and loaded into memory. In practice, the index array would probably be read into memory all at once via an assembly language subroutine, rather than record by record as is shown here.

But the point of the matter is that if an index is read into memory at the beginning of a data entry or edit session, it can be searched repeatedly, without further disk accesses. The BASIC BLOAD statement could also be used, since it too is quick at loading an entire array into memory all at once; but it is limited to use with files of 64K or less.

Because the index file used in Figure 1 contains only the first four characters of each last-name field, the FindMatch subprogram must perform an extra step to ensure that the correct data has truly been found. If a match is established based on the first four characters, the corresponding

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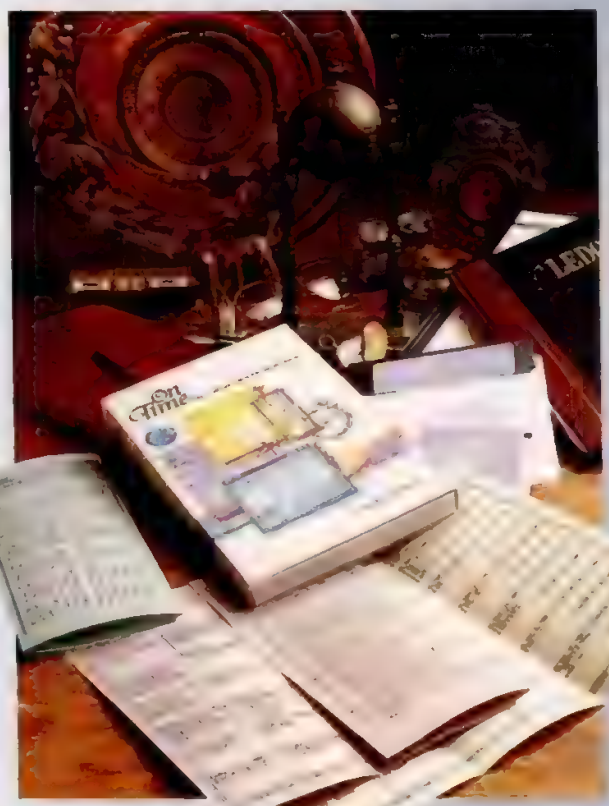

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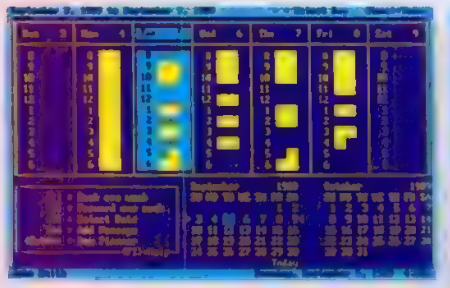

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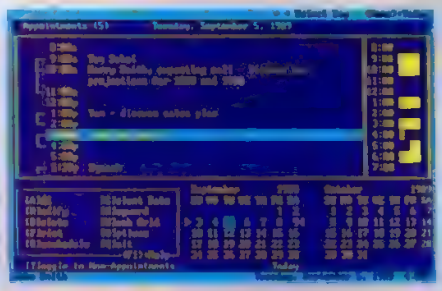

The Day Planner Screen displays each day in 60, 30, or 15 minute increments

CIRCLE 105 ON READER SERVICE CARD

record from the main data file is loaded. Then, the entire search string is compared with the entire last name field to see if the name is really there.

Notice that INSTR is used to see if the search string occurs within the last-name field, rather than performing a direct comparison. Since a last name that is shorter than the maximum field length will be padded with blanks in the file, a direct comparison would no doubt fail. For example, suppose that 15 bytes have been set aside for each last name in the file, and this particular record holds the name "Smith". In truth, the name will be read from disk as "Smith " (notice the trailing spaces), which will obviously not match the "Smith" entered by the operator.

This subprogram is just an example. There is no mechanism for continuing a search if the name that was found is not the correct one. Since it is possible that more than one person with the same last name will be in the database, such a provision would be a required feature for a real-world database program. There is also no provision for finding a match that is "equal to or greater than" or "equal to or less than" the specified string. These comparative strings would also be required in a commercial-quality application.

Although the program shown in Figure 1 will search memory substantially faster than a disk-based searching routine, there is still much room for improvement. Since assembly language is usually the best way to obtain the fastest speed, Figure 2 shows an assembly language subroutine that can be called from BASIC to search an integer array for a match. The FindInt routine was written to take advantage of the new simplified methods available in MASM 5.1 and later.

To use FindInt with a QuickBASIC or BASIC 7 program, you must first assemble it and then create a Quick Library so that it can be accessed from within the QB or QBX environments. Quick Libraries are created using the LINK program that comes with your version of BASIC by entering the following command:

```
LINK /Q FINDINT.OBJ , , NUL,
qlbname;
```

where qlbname represents the special library file that has been provided with your version of BASIC. This file is needed whenever a Quick Library is built. In QuickBASIC 4.5, this file is named BQLB45.IB, and in BASIC 7 it is called QBXQLB.LIB. Other versions of Microsoft BASIC may use different names for this file, and you should consult your BASIC manual in order to determine the correct name for your version.

FINDINT ROUTINE — COMPLETE LISTING

```
;Usage example:
;
;CALL FindInt(SEG Array%(1), Search%, NumEls%, FoundAt%)
;IF FoundAt% THEN
;   PRINT "Found at element number" FoundAt%
;ELSE
;   PRINT "Not found"
;END IF

.Model Medium, Basic
.Code

FindInt Proc Uses DI, Array:DWord, Search:Word, NumEls:Word, Found:Word

    Les  DI,Array          ;load the segmented array address
    Mov  BX,Search         ;get the address for the search value
    Mov  AX,[BX]           ;now AX holds the value to search for
    Mov  BX,NumEls         ;get the address for NumEls%
    Mov  CX,[BX]           ;now CX holds the number of elements
    Mov  DX,CX             ;copy this to DX for later
    Mov  BX,Found          ;get the address for Found%

    Mov  Word Ptr [BX],0   ;assume we won't find a match
    Cld                    ;ensure that searching is forward
    Repne Scasw            ;do the actual search
    Jnz  NotFound          ;it wasn't there

    Sub  DX,CX           ;calculate how far we searched
    Mov  [BX],DX         ;assign the element number to Found%

NotFound:
    Ret                  ;return to BASIC

FindInt Endp
End
```

Figure 2: This assembly language subroutine searches an integer array much faster than an equivalent routine written in a high-level language.

> If an index is read into memory at the beginning of a data entry or edit session, it can be searched repeatedly without further disk accesses.

To load the newly created Quick Library, you simply enter the following command:

```
QB /L FINDINT.QLB
```

or

```
QBX /L FINDINT.QLB
```

The syntax and usage for FindInt are shown in the Figure 2 source file header comments.

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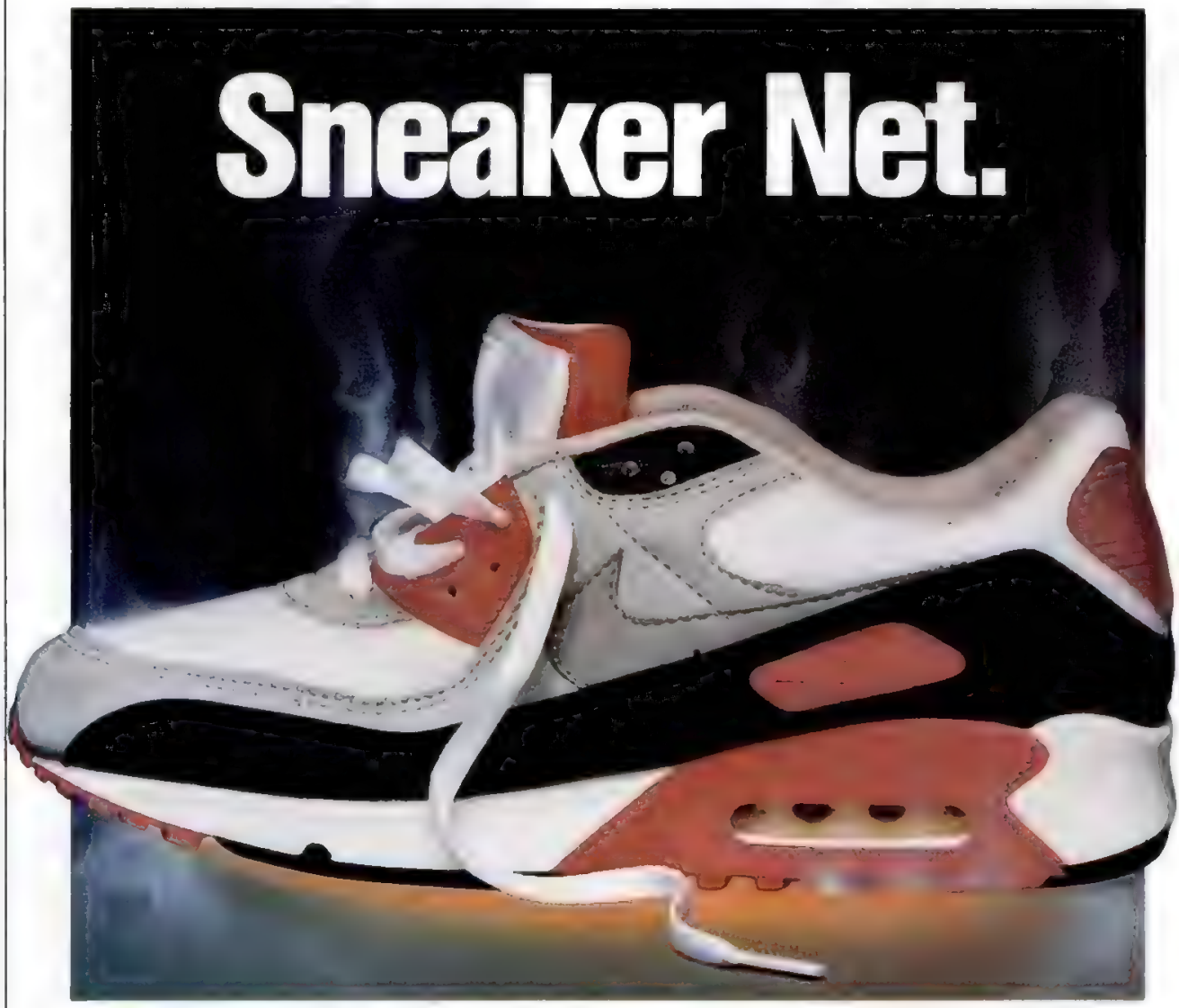
Research for this article was provided by Ethan Winer, a contributing editor of PC Magazine.



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by
Craig Stinson

Spreadsheets

LIMITATIONS TO QUATTRO PRO'S MOUSE PALETTE

One convenient feature in *Quattro Pro* is its mouse palette, which lets you assign macros to buttons along the right side of the screen. You can execute these macros simply by clicking the buttons. Unfortunately, any {?} commands in macros assigned to mouse buttons are ignored when the macros are executed. Though undocumented, this problem was confirmed by Borland, and I was thus faced with the prospect that my simplest but most frequently used macro, @SUM({?})~, could not be invoked from the mouse palette.

I did, however, discover a simple workaround. I wrote a new macro that executes my original macro. Then I attached the new macro to the mouse palette. My original macro was named Sum, so the code for the new one is

```
{/ Name;Execute}Sum~
```

This solution should work for any macro that uses the {?} command.

When using this macro, keep in mind that you need to click the Enter button on the mouse palette or press Enter at the keyboard after marking the block to be summed. If you click the Enter button that appears on the input line, you get an error message indicating that a parenthesis is missing.

Brian Stine
Eugene, Oregon

Quattro Pro's mouse-palette feature does indeed exhibit the undocumented peculiarity described by Mr. Stine. Any {?} commands included in macros assigned to mouse-palette buttons are simply ignored when the macros are executed. No error messages are issued; the system just skips over the {?}s as though they didn't exist. Other interactive commands, such as {GETLABEL} and {GETNUMBER}, work normally in palette-button macros.

The mouse palette has one other undocumented limitation: you can assign no more than 25 characters to any button. In *Quattro Pro*'s command-equivalent macro language, 25 characters are barely enough to write one macro statement.

Because of these limitations, the best way to execute a macro with a mouse-palette button is to do as Mr. Stine describes: write the main macro on the worksheet. Then create a one-statement mouse-palette macro that executes the main macro.

You can also use the mouse palette as a shortcut for executing difficult-to-remember function-key combinations. For example, you could assign the one-statement macro {Macros} to a mouse button and then click that button instead of typing Shift-F3. Similarly, you could assign {Nextwin} to a palette button and then use that as a substitute for typing Shift-F6.

Figure 1 illustrates how you might deploy the mouse palette. The first four buttons retain Borland's default assignments. Button 5 executes the {Macros} key, button 6 executes the {Nextwin} key, and button 7 executes Mr. Stine's Sum macro. The entire palette layout is as follows:

Button	Macro
1	{Esc}
2	~
3	{Del}
4	{Functions}
5	{Macros}
6	{Nextwin}
7	{/ Name;Execute}Sum~

Incidentally, Mr. Stine is also right about

- **LIMITATIONS TO QUATTRO PRO'S MOUSE PALETTE:** A simple workaround lets you overcome the 25-character limit and the inability to use {?}.
- **AN ALTERNATIVE TO THE PASTE SPECIAL COMMAND:** Update worksheet values while keeping a record of the addends.
- **FORGOTTEN EXCEL SHORTCUTS:** A bevy of keystroke combinations that let you bypass menus and dialog boxes.

Figure 1: There are many ways to assign the user-defined functions on *Quattro Pro*'s Mouse Palette (far right on screen). The first four retain Borland's default assignments. Buttons 5 and 6 perform the same functions as pressing Shift-F3 and Shift-F6, respectively. The last button executes another macro, SUM, typed on the worksheet.

the Enter button that appears on the input line as you formulate a cell entry. Clicking this button does not return control to a macro that has used the {?} command to pause for user input. Its failure to do so appears to be a bug.

AN ALTERNATIVE TO THE PASTE SPECIAL COMMAND

Here's a frustrating scenario that a few of my fellow *Excel* users may have experienced at one time or another. Imagine you've just typed 500 sales figures into your spreadsheet and suddenly your boss tells you to add in 500 adjustment figures. Don't you wish you'd known it earlier?

One way to make the adjustments would be to open a new worksheet, enter all the adjustment figures in a column, select the entire column, and copy it to the clipboard. Then go back to the original worksheet, select the first cell in the column needing adjustment, and use the Edit menu's Paste Special command. In the Paste Special dialog box you would select the Values radio button and the Add radio button, then click OK.

This solution is fine; however, I have found the business of creating a new column and using Paste Special to be tedious. As a consequence, I wrote the macro shown in Figure 2.

To use this macro, select the first cell in the column that needs adjustment. Then press Ctrl-A and fill out the dialog box for each cell in the column. At the blank cell after the last item, the macro stops.

Julitta Korol
Brentwood, New York

The Paste Special command is a great consolidation tool, but unfortunately it doesn't show you the derivation of the roll-up figures. The OS/2 version of *Excel* has a Consolidate command that's even more versatile than Paste Special (because it lets you roll up figures from dissimilar worksheets), but it has the same drawback as Paste Special: no audit trail.

It is for this reason that Ms. Korol's macro offers a distinct advantage over the Paste Special command: by converting your original constants to formulas—instead of simply adding the adjustment values into the constants—the macro makes it possible for someone to look at each cell and see the adjustment figures as well as the original numbers.

> A valuable shortcut you don't want to miss is Ctrl-Shift-8. When this command is executed at any cell in a range, *Excel* will immediately select all cells in the current continuous series of rows and columns.

Incidentally, after adjusting your figures with this macro, you still have the option of using Paste Special to convert the formulas back into constants. To do this, you would first select the column of formulas and use Edit Copy to put the formulas on the clipboard. Then you would select the first cell in the column and choose Paste Special. In the Paste Special dialog box, you would choose the Values and None options. When you click OK, *Excel* will replace each formula in the column with its current calculated value.

VALUE UPDATE MACRO — **COMPLETE LISTING**

```
    A            B
1  Ctrl+A       Add_Value
2               =FORMULA("="&(ACTIVE.CELL()&"+"&(INPUT("Enter the value to add:",1))))
3               =SELECT("R[1]C")
4               =IF(ISBLANK(ACTIVE.CELL()),GOTO(B6))
5               =GOTO(B2)
6               =RETURN()
```

Figure 2: This macro, which duplicates the Option menu's Paste Special function, lets you update a range of numbers. While not necessarily faster than Paste Special, the macro is more efficient: it lets you see the original values that make up the sum.

FORGOTTEN EXCEL SHORTCUTS

I've noticed an important omission in a recent *PC Magazine* discussion of *Excel* range selection. No mention was made of the handy Ctrl-Shift-8 keystroke combination, which selects the current cell block. Execute this command at any cell in a range, and *Excel* will immediately select all cells in the current continuous series of rows and columns. I find this command invaluable for setting print ranges and databases and consequently feel that it deserves attention.

Max Montgomery
Felton, California

I'd bet my mouse that many an *Excel* user has overlooked this valuable keyboard shortcut. It's not hard to miss, because Microsoft buried the information in a table of arcane shortcuts for bypassing menus and dialog boxes. Why would Ctrl-Shift-8 be listed there? Because it's a shortcut for the Current Region option of the Formula Select Special command!

This table—on pages 440 to 441 of the *Excel* 2.1 reference manual—lists a number of other shortcuts, but you'd have to be a savant to remember most of them. For example, are you aware of the fact that Ctrl-[is a keyboard accelerator for Select Special's Precedents: Direct Only option? A few of the items on the list are both mnemonic and useful, however. The following three formatting shortcuts might be easy enough to assimilate into your keyboard repertoire:

- Ctrl-Shift-4 formats the current selection as currency with two decimal places.
- Ctrl-Shift-5 formats the current selection as a percentage with no decimal places.
- Ctrl-Shift-6 formats the current selection in scientific notation with two decimal places.

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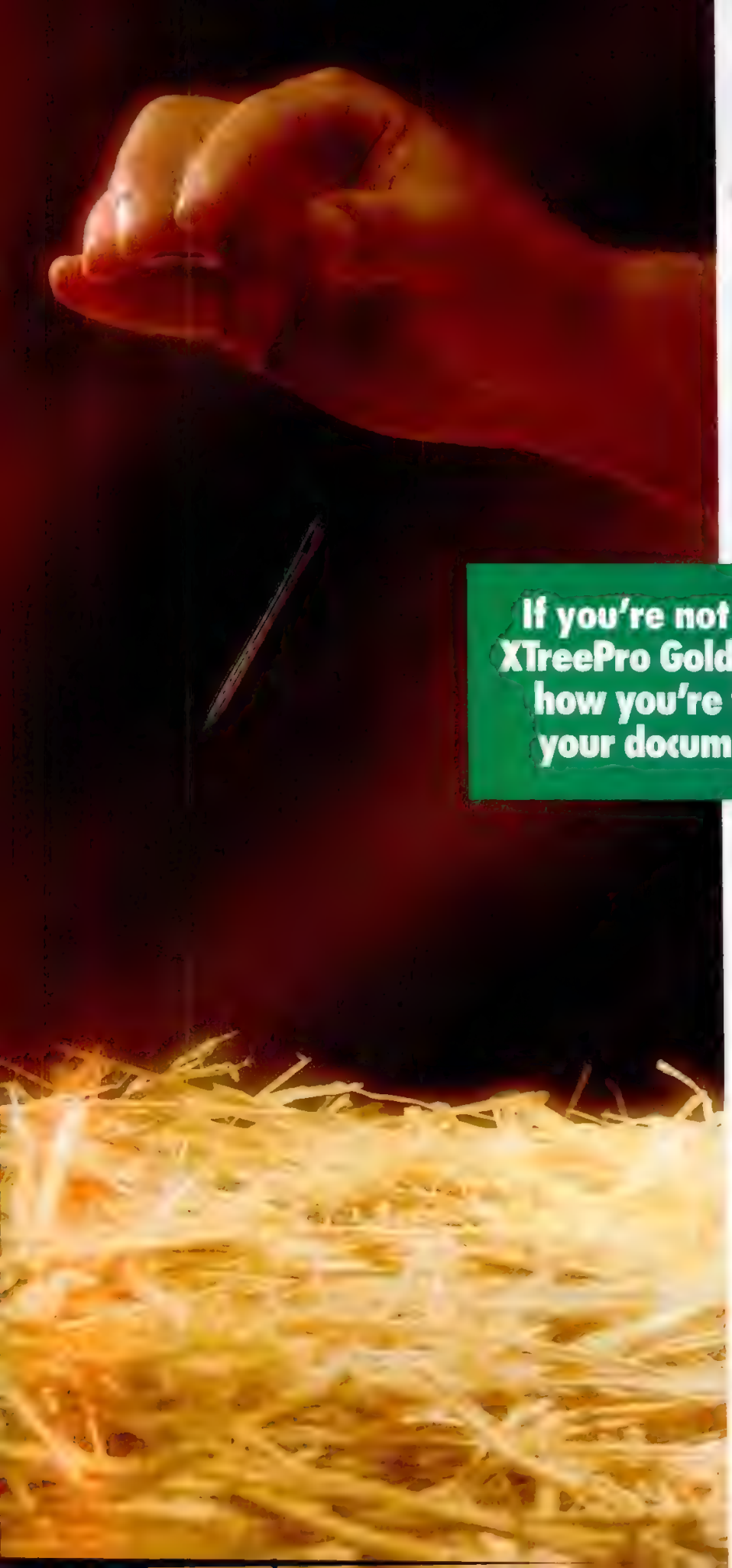

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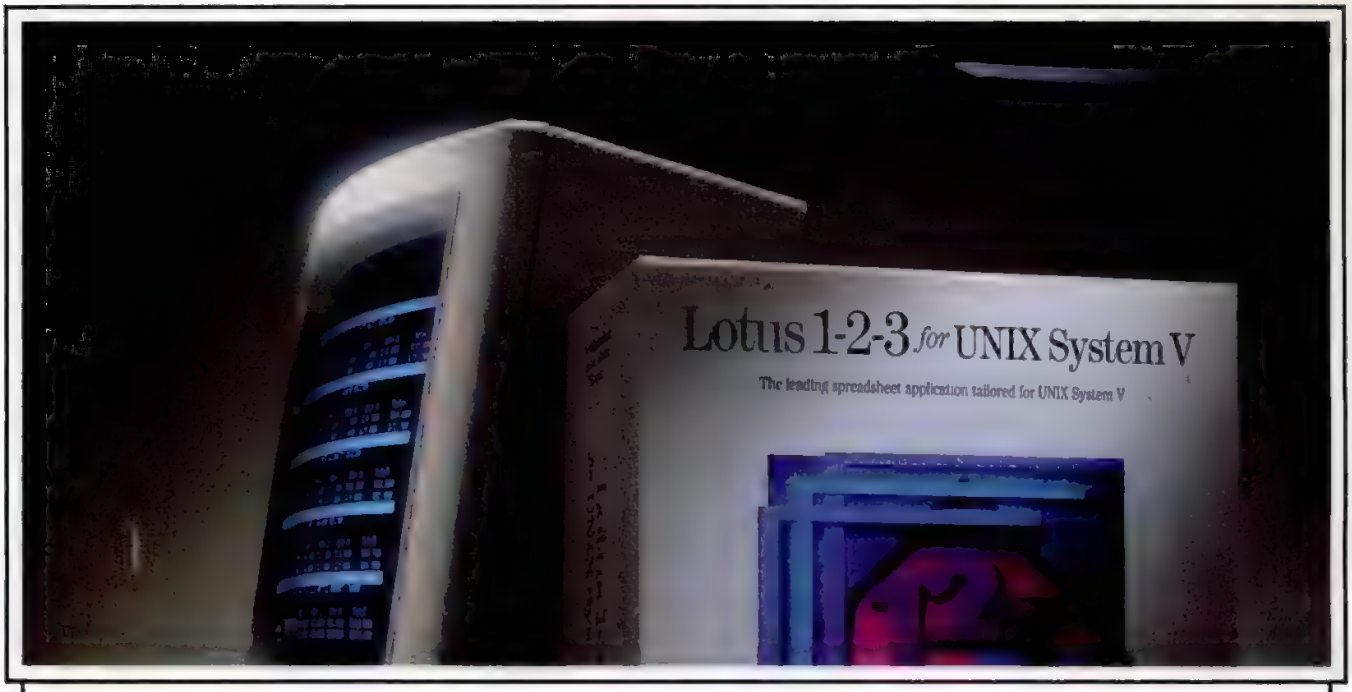

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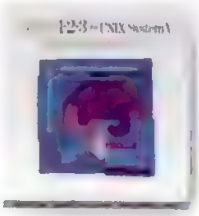

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by
Craig L. Stark

The Working Word

People who work with words are often paid by the word. Therefore, in addition to a spell-checker and thesaurus, full-featured word processors like *XyWrite*, *WordPerfect*, and *Microsoft Word* now all contain functions that will tell you how many words there are in a particular document. In *WordPerfect* you can pick the Count option (6) from the Spell menu; Page Repaginate will tell you the number of lines and words in your *Word* document. *Word for Windows*' menus take you down to the second level of the Document Summary to get your word count; in *XyWrite* you simply enter WC from the command line.

However, writers and programmers alike often want to know something other than the total number of words. It's frequently desirable to be able to count the number of times a given word, phrase, or even character—such as an open parenthesis or curly bracket—recurs. The demand for this kind of feature has recently exercised the ingenuity of a number of our readers.

- **MACROLESS COUNTING IN WORD:** You can tell how many times you've used a word in a document.
- **COUNTING IN WORDPERFECT:** A macro counts the occurrence of a word in Versions 5.0 and 5.1.
- **KEEPING COUNT IN XYWRITE:** A word-use counting program can be a snap in the *XyWrite* programming language.
- **LINE-DRAWING TIPS:** The Esc key speeds the operation of this *WordPerfect* feature.

MACROLESS COUNTING IN WORD

Did you ever want to know how many times you used a certain word or phrase in the document you're writing? If you use *Microsoft Word* (or any other word processor that counts the number of times it replaces a given word) you're in luck. Without leaving the document, simply use the Replace command to replace the word with itself. When *Word* is finished it displays the number of times that it found and "replaced" the word.

You'll probably want to choose not to "confirm" each "change," and you should be sure to select the "whole word" option. In this way, if you were counting the number of times you used the word *the*, for example, the program wouldn't register its occurrence in *other*. Furthermore, *Word* gives you the choice of requiring case-matching or not and of restricting your search to a defined block of text.

Bill Kraengel
Valley Stream, New York

Mr. Kraengel's solution is of the "Why didn't I think of that?" variety; it works in both *Word* and *Word for Windows*. (In the latter the message reporting the number of occurrences disappears after a few moments.) Users of *WordPerfect* must seek a different kind of solution, as seen next.

COUNTING IN WORDPERFECT

The *WordPerfect* macro shown in Figure 1 will count any letter, word, or phrase in a document. To use it to determine the number of times *the* occurs, for example, simply invoke the macro by name (I call it COUNT.WPM) with Alt-F10 and, at the prompt, enter <space>the<space>. The macro works in either Version 5.0 or 5.1.

Pete Unger
Fort St. James, British Columbia
Canada

You'll have to use WP's Macro Editor to enter Mr. Unger's macro, but it's short and it works. The spaces on either side of *the* in the example above would obviously not be included if you were searching for a character rather than a whole word; indeed, the second space will cause you to miss occurrences where there is an immediately following punctuation mark. Note too, that *WordPerfect*'s search function is designed so that if you enter the search string in lowercase, it will also register uppercase occurrences, but not vice versa: uppercase search letters match only uppercase targets.

To round out the treatment of counting characters, phrases, or words among these high-power word processors is the following short *XyWrite* program, which was actually written by my son.

COUNT.WPM — COMPLETE LISTING

```
{DISPLAY OFF}
{HOME}{HOME}{HOME}{Up}
{ASSIGN}0~~
{ASSIGN}1~0~
{TEXT}0~letter, ·word·or·phrase·to·be·counted=>~
{ON NOT FOUND}{GO}tell~~
{LABEL}search_loop~
     {Search}{VAR 0}{Search}
    {ASSIGN}1~{VAR 1}+1~
{GO}search_loop~ {LABEL}tell~
    {CHAR}0~"{VAR 0}"·occurs·{VAR 1}·times·(press·any·key)~
     {ASSIGN}0~~     {ASSIGN}1~~
    {DISPLAY ON}
    {HOME}{HOME}{Down}
```

Figure 1: This is how the COUNT.WPM macro will look in WP's Macro Editor. The dots between words represent spaces, and the boldface commands are imported from the command menu.

The Working Word

KEEPING COUNT IN XYWRITE

Several years ago I developed the COUNT .PGM macro shown below. The program lets me count the occurrence of words, characters, or phrases in *XyWrite*. To invoke it, go to *XyWrite*'s command line with F5 and enter

```
RUN COUNT string
```

The *string* is what you want counted.

When viewed (or entered) in *XyWrite*'s expanded mode so that the code is visible, the program is as follows:

```
DX BC es 1BC «SX01,0»
«SX02,«CP»»«LBSTART»
BC SE /«PV00»/BC
 «IF«ER»»«GLEND»«EI»
«SX01,«PV01»+1»«GLSTART»
«LBEND»BC JMP «PV02»BC DO BC es 0
BC BC «PV01» occurrences «EX1»
```

First, the program turns off the updating of the display and suppresses any error messages generated during its execution. After this, it then initializes the first variable (SX01) to zero. This will serve as the counter. Next, it saves the current cursor position in the second variable (SX02). After this, it executes a search for the *string* you entered on the command line (this is automatically SX00). Each time it finds a match, it increments the counter variable. When no more matches are found, an error is detected, and processing jumps to the end label (LBEND). At this point the cursor is restored, the display updating and error message prompts are reactivated, and the program reports the number of occurrences found.

As written, COUNT is case insensitive; change the SE to SEA to make it case sensitive. The *string* may not include the / character (you could substitute another delimiter), but may consist, if desired, simply of a carriage return (Ctrl-Enter on the command line) or tab character for counting paragraphs quickly.

C. E. L. Stark
Cambridge, Massachusetts

One reason that I haven't published a large number of helpful *XyWrite* programs in The Working Word is that XPL (the *XyWrite* Programming Language) is so terse that it is not easy to render intelligible to nonusers. In the seven lines of code shown above there are *no* carriage returns. This means that the program must be entered as a single string, exactly as shown, after opening a new program file (NEP COUNT) and toggling into expanded mode (Ctrl-F9). The function calls, which are shown in boldface, are then entered from the *XyWrite* command line as PFUNC DX (turn off display update), PFUNC XC (execute), and so on. The E and . . characters are entered in expanded mode with Ctrl-< and Ctrl->, respectively.

> *XyWrite*'s programming language is capable of performing some amazingly sophisticated maneuvers, and once you've gotten into it, you'll see that it's not as intimidating as it looks initially.

However, like the program itself, *XyWrite*'s programming language is capable of performing some amazingly sophisticated maneuvers, and once you've gotten into the language, you'll see that it's not as intimidating as it looks initially.

In order to increase the accessibility of XPL, XyQuest has recently published a supplement, *The XyWrite Programming Language User's Guide*, which contains a good many tips, tricks, and illustrative programs (including a rather similar COUNT.PGM) that go well beyond the limited treatment provided in the regular user's manual.

LINE-DRAWING TIPS

I have found that it is possible to speed up the operation of the line-drawing feature in *WordPerfect* by a considerable amount if you use the Esc key. This trick works in Versions 4.2 and 5.0. The following directions assume you have already activated the line-draw feature (Ctrl-F3,L).

To draw a horizontal line 20 characters long, tap the Esc key, type 20, then tap the Right Arrow key.

To draw a vertical line 30 lines high, tap the Esc key, type 30, then tap the Down Arrow key.

When you are in line draw, the Home and End keys do not operate. This means that moving to the top or bottom, or left or right margins of your drawing can prove to be a rather slow procedure. Once again, the Esc key can help you overcome this limitation.

To move your cursor to the top of your document, go into the line-draw feature, tap 6 to choose the move feature, tap the Esc key, type 100, then tap the Up Arrow key. Note that 100 is arbitrary here; depending on how far down you start, you may have to repeat this process to actually get to the top of the document.

Similarly, in order to move your cursor to the bottom of the document, you must go into the line-draw feature, tap 6 in order to choose the move mode, hit Esc, type 100, and finally tap the Down Arrow key. With the same sequences, the Left Arrow and Right Arrow keys move you to the left and right margins.

Betsy Gurlacz
Chicago, Illinois

Ms. Gurlacz's tips work out in *WP* 5.1 as well. On my machine at least, they seem to execute even more quickly in 5.1 than in 5.0. It seems strange that neither manual mentions her suggestions, since the line-drawing option has long been one of *WordPerfect*'s more popular features.

Note that *WP* does caution that the line-drawing option is limited to use with monospace fonts and that for many users' documents the Graphic Lines and Tables features may provide better alternatives than the more-conservative line-draw techniques.

TIPS FROM WORKING WORDSMITHS

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by
Neil J. Rubenking

User-to-User

BY ANY OTHER NAME

I've found an undocumented command, TRUENAME, in MS-DOS 4.01. TRUENAME seems to be an internal DOS command. It takes an optional filespec as its parameter and returns the *real* filename or pathname to the standard output device. TRUENAME can see through ASSIGN, JOIN, and SUBST redirection. Here are a few demonstrations of what it can do.

First, make sure that ASSIGN.COM and COMMAND.COM are accessible on your path. Now, copy them to your A: drive and create a file called TESTFILE. Make certain that TESTFILE exists on drive A: and *not* on drive C:.

Try TRUENAME with no parameters. You'll see the current directory. Try TRUENAME with a nonexistent filename. We checked earlier that TESTFILE doesn't exist on C:\, so enter TRUENAME TESTFILE at the C: prompt. The name C:\TESTFILE is returned—the name the file would have if it existed. Now let's get really carried away with a nonexistent path—TRUENAME C:\XYZ*.BAK. The result is C:\XYZ\????????.BAK

- **BY ANY OTHER NAME:** An undocumented DOS 4.x command unscrambles SUBST, ASSIGN, and JOIN.
- **SHIFTING AROUND:** This tiny program makes your Caps Lock key act like the Shift Lock on a typewriter.

Let's see what happens under ASSIGN redirection. Give the command ASSIGN C=A and then enter TRUENAME C:TESTFILE. We know that the true name is A:\TESTFILE—and TRUENAME reveals that the file is actually on drive A:.

Now we'll get rid of the ASSIGN and try out TRUENAME under SUBST redirection:

```
ASSIGN C=C
SUBST E: C:\WINDOWS
TRUENAME E:WIN.INI
```

C:\WINDOWS\WIN.INI is displayed—TRUENAME saw through SUBST and returned the actual physical name. Let's try JOIN now and see what happens . . .

```
SUBST E: /D
JOIN A: C:\DRIVE-A
TRUENAME DRIVE-A\ASSIGN.COM
```

Again, TRUENAME caught that the file was physically on drive A:.

Walter Dnes
Willowdale, Ontario
Canada

Superstition holds that if a sorcerer learns your true name he gains power over you. But it's no superstition that TRUENAME gives you power in your drives and directories. SUBST lets a subdirectory masquerade as a drive, ASSIGN lets one drive pose as another, and JOIN lets a drive pretend to be a subdirectory. These aliases can be handy, but they confuse certain utilities that need low-level access to the disk. For example, you can't run *PC Magazine*'s CHKFRAG.EXE on a disguised disk.

The TRUENAME command in DOS 4.*x* uses undocumented DOS function 60h, introduced in DOS 3.0. For those of you who want to experiment with this function under DOS 3.*x*, I've cobbled together a tiny program called TRUE.COM. Carefully type in the DEBUG script in Figure 1, making sure to insert blank lines after the JMP 170 line, the INT 20 line, and the final Q. The words after the semicolon

TRUE.SCR — **COMPLETE LISTING**

```
NTRUE.COM
A100
JMP 170                     ;jump over data area to START

F 102 16F '$'
E 150 'Bad parameter'
E 160 'I need DOS 3:'
A170
MOV  AX,3000                ;:START
INT  21                     ;get DOS version
CMP  AL,3
JAE  17E                    ;if it's 3 or greater, go to OK
MOV  DX,160                 ;otherwise complain and ..
JMP  19C                    ;.. go to DONE
XOR  BX,BX                  ;:OK
MOV  BL,[0080]
ADD  BL,81                  ;make filename on command line into
MOV  BYTE PTR [BX],00       ;an ASCIIZ string
MOV  SI,0082                ;point SI at filename
MOV  DI,0102                ;point DI at result area
MOV  DX,DI                  ;point DX at result too
MOV  AX,6000
INT  21                     ;call true name function
JNC  019C                   ;If the call succeeded, goto DONE
MOV  DX,0150                ;otherwise point to error message
MOV  AX,0900                ;:DONE
INT  21                     ;print the message pointed to by DX
INT  20

RCX
A3
W
Q
```

Figure 1: This DEBUG script creates a program that imitates TRUENAME, an undocumented DOS 4.*x* command that can see through ASSIGN, JOIN, and SUBST redirection.

on some lines are comments—you can type them in or omit them. Then enter the command

```
DEBUG < TRUE.SCR
```

to create TRUE.COM.

TRUE.COM requires a parameter—if you want the true name of the current drive, you should use TRUE \. For the true name of the current directory, TRUE . will do the job. It's possible to check the true names of other drives as well, but you must be sure to specify a path, for example TRUE W:\FINAL or TRUE W: . If the DOS function call fails, you'll get the message "Bad parameter," and if you try to use TRUE.COM under DOS < 3, it will tell you "I need DOS 3!"

SHIFTING AROUND

The behavior of the Caps Lock key on the PC keyboard can be annoying to touch-typists. When we turn it on to enter all uppercase letters, our typing reflexes still cause us to press a Shift key to capitalize proper names or other words or phrases. Instead of ignoring this extra Shift key as redundant, the keyboard BIOS regards it as a request to reverse the shift state and enter a lowercase letter. As a result, we frequently see items such as hAPPY nEW yEAR, or jOHN q. pUBLIC.

SHFTLOCK.COM is a small memory-resident keyboard handler designed to eliminate this problem. Whenever you press a key, SHFTLOCK checks to see whether one of the Shift keys is already down. If so, it further checks whether Caps Lock is engaged. If the answer to both queries is positive, SHFTLOCK temporarily turns off the Caps Lock bit in low memory. It allows the BIOS to process the keystroke, and then turns the Caps Lock bit back on before it exits.

To create the program, use a pure-ASCII editor to enter SHFTLOCK.SCR (Figure 2). Be sure to include the blank lines before the RCX and after the Q. Then make sure DEBUG is available on your PATH and enter the command

```
DEBUG < SHFTLOCK.SCR
```

Load the resulting program file at start-up time from your AUTOEXEC.BAT file.

It's true, one person's bug can be another's feature—and some users may prefer working with, rather than around, this keyboard peculiarity. For those who have never quite adjusted to it, SHFTLOCK can help.

Gerald A. Monroe
Lakewood, Ohio

SHFTLOCK.SCR — COMPLETE LISTING

```
NSHFTLOCK.COM
A100
JMP  13C                    ; JUMP TO INSTALLATION
NOP
NOP                         ;  STORAGE SPACE FOR
NOP                         ;  OLD KEYBOARD VECTOR
NOP
STI                         ; INTERRUPTS ON
PUSH AX
MOV  AH,2                   ; GET SHIFT STATUS
INT  16                     ; FROM BIOS
TEST AL,3                   ; IS EITHER SHIFT PRESSED?
JZ   114                    ; NO, EXIT TO BIOS
TEST AL,40                  ; IS CAPSLOCK ALREADY ON?
JNZ  11A                    ; YES, DO OUR ROUTINE
POP  AX                     ; CLEAN UP STACK AND
CS:                         ; EXIT TO BIOS ROUTINE
JMP  FAR [102]
PUSH DS                     ; SAVE CALLER'S DATA SEG
MOV  AX,40                  ; ADDRESS BIOS DATA AREA
MOV  DS,AX
AND  BYTE PTR [17],BF       ; MASK OFF CAPSLOCK BIT
POP  DS
POP  AX
PUSHF                       ; LET BIOS PROCESS
CS:                         ;  THIS KEYSTROKE
CALL FAR [102]
PUSH AX                     ; WHEN IT'S DONE...
PUSH DS
MOV  AX,40                  ; GO TO BIOS DATA AREA
MOV  DS,AX
OR   BYTE PTR [17],40       ; MASK CAPSLOCK ON AGAIN
POP  DS                     ; CLEAN UP STACK
POP  AX
IRET                        ; AND EXIT (END OF RAM-RESIDENT CODE)
MOV  AX,3509                ; INSTALLATION: GET OLD
INT  21                     ;  KEYB VECTOR THROUGH DOS
MOV  [102],BX               ; SAVE OFFSET LOCALLY
MOV  [104],ES               ; AND SEGMENT TOO
MOV  AX,2509                ; REROUTE KEYB VECTOR CHAIN
MOV  DX,106                 ; TO POINT TO OUR CODE
INT  21                     ; USING DOS
MOV  DX,13C                 ; POINT TO END OF HANDLER
INT  27                     ; TERMINATE, STAY RESIDENT

RCX
56
W
Q
```

Figure 2: SHFTLOCK.COM is a small memory-resident keyboard handler created with this DEBUG script. It makes your Caps Lock key act more like the Shift Lock on a typewriter.

Probably anyone who first learned to type on a typewriter has experienced the sHIFT lOCK pROBLEM, and SHFTLOCK.COM is the remedy. It's not terribly *smart*—it can't unload itself from memory, and it won't stop you from loading it over and over. But it's so small that you won't begrudge the RAM it takes.

Every program inherits a copy of the DOS environment, even TSRs like this one. If your environment is large, SHFTLOCK's useless copy of it might be bigger than the program itself. To avoid wasting valuable RAM, load SHFTLOCK before setting your PATH, PROMPT, or any other environment variables. This advice holds true for most TSR programs, though there may be some that require access to the PATH or to particular environment variables.

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3. Slice the folded edge
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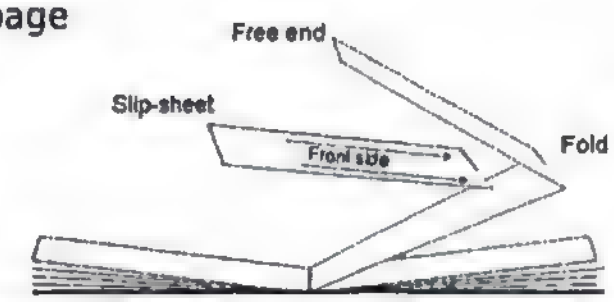

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1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

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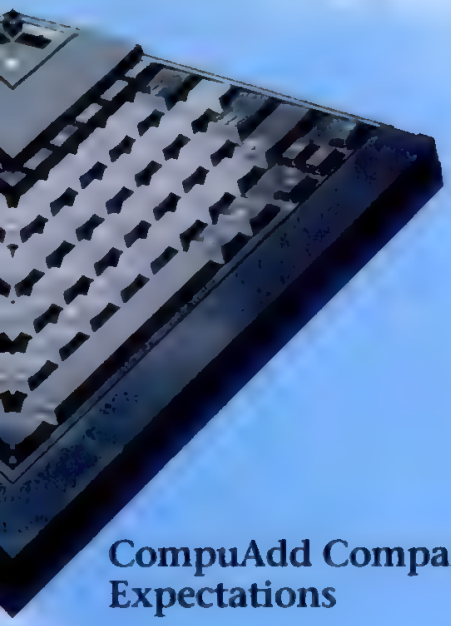

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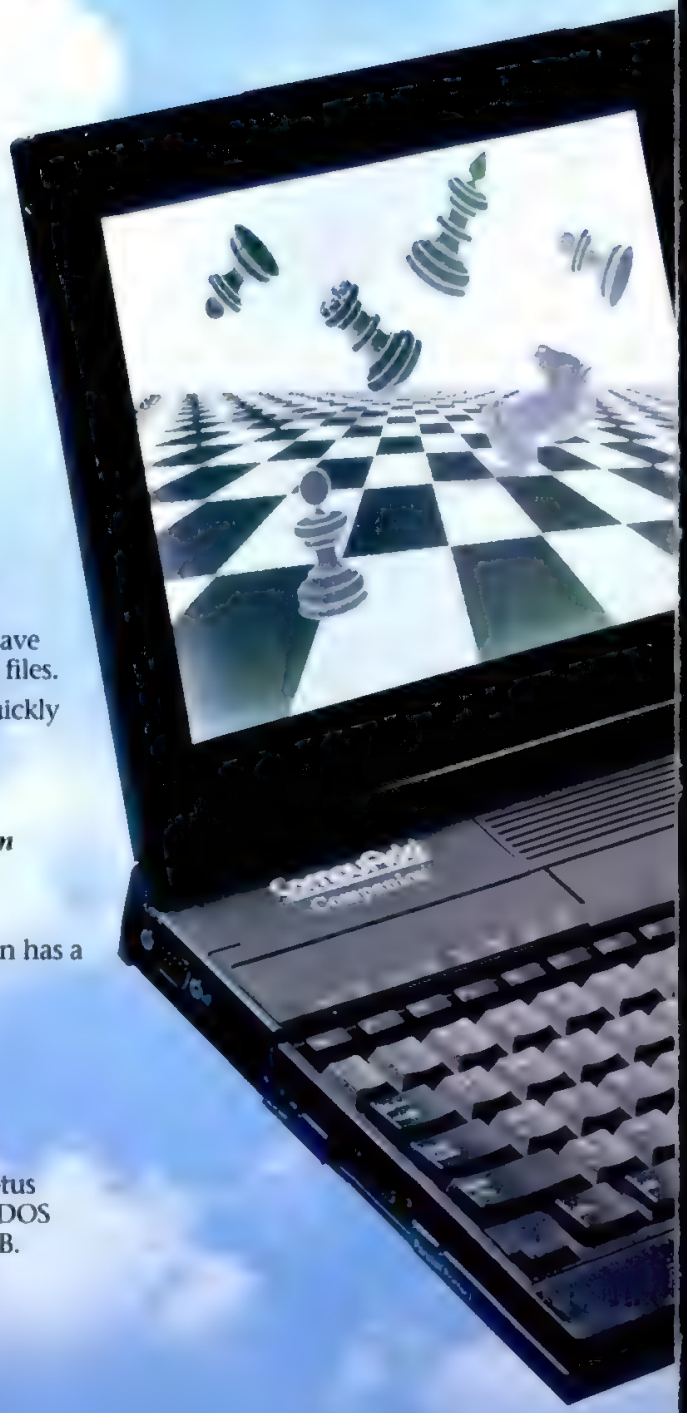

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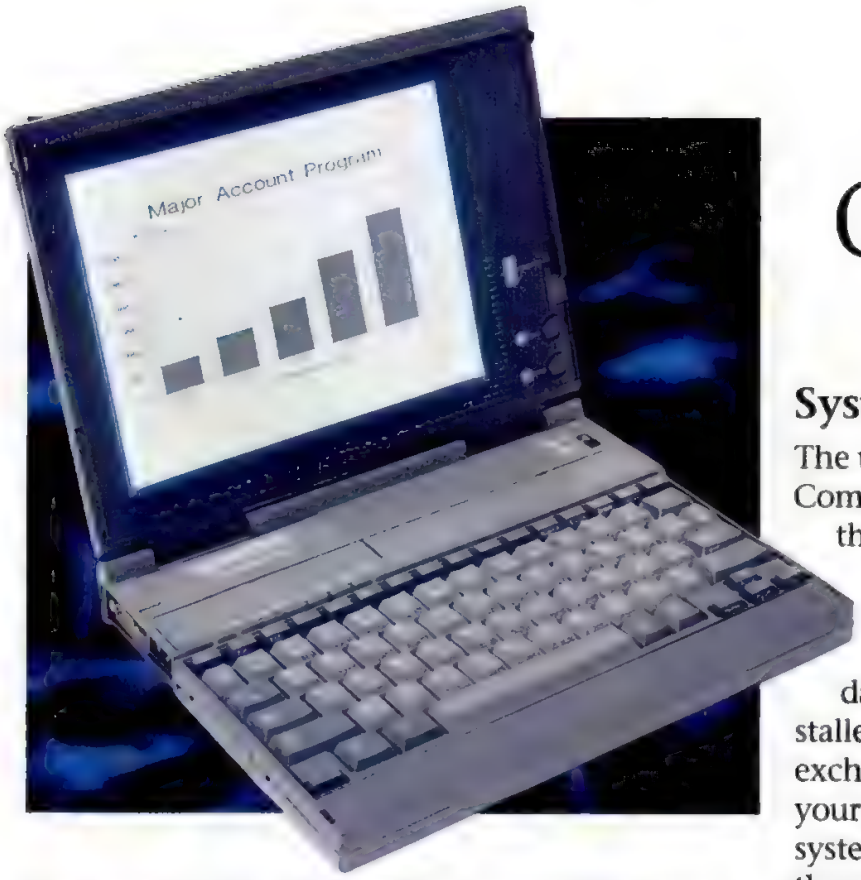

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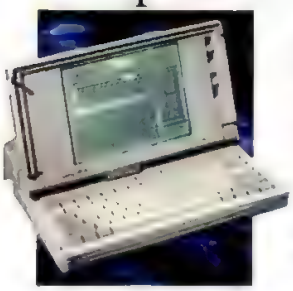

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by
Jeff Prosise

Tutor

NULL-MODEM CABLES

Figure 1 shows two diagrams for null-modem cables: one that appeared in *PC Magazine*'s January 17, 1989, Lab Notes column, the other for a null-modem cable sold by a popular mail-order house. Why are they different? Shouldn't all null-modem cables be similarly wired? And will both cables work with *PC Magazine*'s ZCOPY utility, which also appeared in the January 17, 1989, issue?

William H. Dixon
Leesburg, Florida

- **NULL-MODEM CABLES:** They provide direct PC-to-PC communications, but no standard defines how they should look.
- **IDENTIFYING MATH COPROCESSORS:** Here's how to tell what type of NDP you have.

Not all null-modem cables are created equal. The Electronics Industries Association (EIA) RS-232 specification from which we derive our standards for asynchronous serial communications doesn't address the issue of direct PC-to-PC communications and therefore doesn't delineate what a null-modem cable should look like. As a result, you'll find several different variations on the "standard" null-modem cable. Whether or not a given cable will work with a selected piece of software depends on how the RS-232 control pins are used to control the flow of data.

In its simplest form, a null-modem cable is nothing more than a serial cable with pins 2 and 3—the Transmit Data (TD) and Receive Data (RD) pins—crossed so that what is transmitted on pin 2 at one end will show up on pin 3 at the other, and vice versa. If no handshaking is performed at the hardware level, this arrangement is sufficient for rudimentary but effective data transfer between devices.

What is hardware handshaking? By definition, hardware handshaking is performed when two programs manipulate RS-232 control pins—DTR, DSR, RTS, and CTS—to achieve a hardware-based form of flow control. For example, in DTR/DSR handshaking, the sender asserts DTR (Data Terminal Ready) before sending the first character in a stream of data and waits for DSR (Data Set Ready) to be asserted in return. RTS/CTS handshaking works in a similar manner, but uses the Request To Send and Clear To Send pins rather than Data Terminal Ready and Data Set Ready. In either case, the sender delays transmitting data until the receiver is ready. Many serial communications programs use these or similar forms of handshaking to ensure that the PC on the transmitting end doesn't attempt to send data before the PC on the receiving end is prepared to accept it.

An alternative to hardware handshaking is software flow control. Programs that use the popular XON/XOFF flow-control protocol, for example, send special XON and XOFF characters (binary codes 17 and 19, respectively) to regulate the flow of data. If the receiver detects an impending buffer-full condition, for example, it transmits an XOFF character signaling the sender to suspend data transmission. When it's prepared to accept more data, it sends an XON character telling the sender to resume. Other alternatives are to forgo

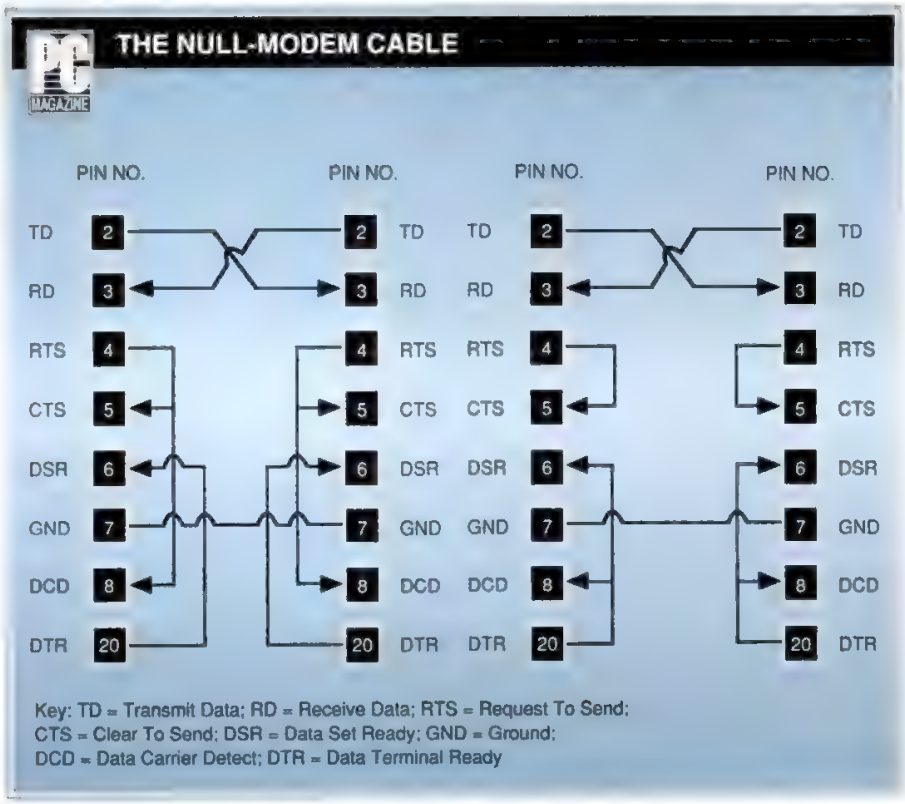

Figure 1: Here are two variations of the "standard" null-modem cable. There is no recognized standard for wiring null-modem cables, because the EIA RS-232 specification does not concern itself with direct PC-to-PC communications issues.

flow control altogether, or to use a packet-based file-transfer protocol such as Kermit or Xmodem.

The advantage to using a file-transfer protocol is that it's relatively easy to build-in error-checking logic, ensuring not only that the sending and receiving devices communicate with each other, but also that what comes across the line is free from random errors.

A typical null-modem cable is wired to short-circuit a program's dependency on any RS-232 pins other than TD and RD. Both cables shown in Figure 1, for example, work equally well with programs that employ DTR/DSR handshaking, RTS/CTS handshaking, or no handshaking at all. In addition, both cables tie an RS-232 output into DCD just in case the software running on the PC won't work unless Data Carrier Detect is asserted. The only difference is the physical wiring of DCD: the cable on the left loops the RTS output into DCD, while the one on the right loops DTR into DCD.

Will these null-modem cables work with ZCOPY? Yes. ZCOPY uses a packet-based data-transfer protocol in lieu of handshaking. The transfer isn't unlike an Xmodem upload or download; the sender transmits a packet of data, complete with a CRC value and other control information, and the receiver either acknowledges the packet and its contents or asks the sender to retransmit the packet. As a result, ZCOPY will work with virtually any null-modem cable—the only requirement being that TD and RD appear on opposite pins on opposite ends.

WHATNDP.SCR — **COMPLETE LISTING**

```
N WHATNDP.COM
A
JMP     0136
DB      0D,0A,"No NDP installed",0D,0A,"$"
DB      0D,0A,"NDP is an 80$"
DB      "87$"
DB      "287$"
DB      "387$"
DB      0D,0A,"$"
DB      0,0
FINIT                           ;Check for coprocessor
FSTCW   [0134]                  ;  by initializing it
CMP     BYTE PTR [0135],3       ;  and looking at the
JZ      014B                    ;  bits 8 and 9 of the
MOV     AH,9                    ;  control word
MOV     DX,0102                 ;Exit if there's nothing
INT     21                      ;  there
RET
MOV     AH,9                    ;Print opening message
MOV     DX,0117
INT     21
MOV     DX,0126                 ;Test for 8087 by seeing
AND     WORD PTR [0134],FF7F    ;  if the FDISI instruction
WAIT                            ;  sets the IEM bit in the
FLDCW   [0134]                  ;  coprocessor control word
WAIT
FDISI
WAIT
FSTCW   [0134]
TEST    WORD PTR [0134],80
JNZ     018F                    ;Branch if NDP is an 8087
MOV     DX,0129                 ;Distinguish between 287
FINIT                           ;  and 387 by determining
FLD1                            ;  whether the NDP is
FLDZ                            ;  initialized to affine
FDIVP   ST(1),ST                ;  (387) or projective
FLD     ST(0)                   ;  (287) infinity
FCHS
FCOMPP
FSTSW   [0134]
WAIT
MOV     AX,[0134]
SAHF
JZ      018F                    ;Branch if 287
MOV     DX,012D                 ;It's a 387!
MOV     AH,9                    ;Print NDP type and exit
INT     21
MOV     AH,9
MOV     DX,0131
INT     21
RET

RCX
9B
W
Q
```

Figure 2: This DEBUG listing creates WHATNDP.COM, a short utility that reveals whether or not there's a math coprocessor installed in the PC it's run on, and if there is, whether it's an 8087, 287, or 387. Be sure to include the blank line between RET and RCX near the end of the listing.

IDENTIFYING MATH COPROCESSORS

In a recent Tutor column, we developed a short program called WHATCPU, which identifies the type of CPU it's running on. This time we'll build WHATNDP, a program that identifies what type of Intel math coprocessor—if any—is present in the host PC.

The best all-around set of routines I've seen for identifying Intel NDPs (Numeric Data Processors) came to us a couple of years ago, courtesy of reader Baron L. Roberts. WHATNDP incorporates a slightly modified version of his routines. Like WHATCPU, which relies on known differences between the various Intel CPUs to identify CPU types, WHATNDP uses documented differences in the Intel NDP chips to distinguish between 8087s, 80287s, and 80387s.

The DEBUG listing for WHATNDP .COM is shown in Figure 2. The first test it applies is one that was presented in the March 13, 1990, Tutor column for determining whether or not there's a math coprocessor installed. An FNINIT is executed to initialize the coprocessor (if it's there) and the coprocessor control word is transferred to a memory location where it can be inspected. FNINIT sets bits 8 and 9 of the control word on all Intel math chips. Thus, if bits 8 and 9 of the memory location that the control word was transferred to are set after the operation is complete (the memory location was originally set to 0), WHATNDP concludes that there must be a coprocessor present.

The next test separates 8087s from 287s and 387s. The key is that the coprocessor instructions FDISI and FENI, which disable and enable coprocessor interrupts by setting and clearing the IEM (Interrupt Enable Mask) bit in the coprocessor control word, are ignored on the 287 and 387 but not on the 8087. WHATNDP manually clears the IEM bit, then executes an FDISI

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instruction and then proceeds to read the control word back. If the NDP is an 8087, the IEM bit will be set; if it's a 287 or 387, it will not.

The final test differentiates between 287s and 387s. It relies on FINIT initializing the 287 to use *projective* infinity, where positive and negative infinity are equal, but initializes the 387 to use *affine* infinity—where positive and negative infinity appear at opposite ends of the number line.

In fact, the 387 uses affine infinity only; it ignores the setting of the control word's Infinity Control (IC) bit, which switches between affine and projective infinity on the 8087 and 287.

In order to gauge which infinity control mode is in effect after FINIT is executed, WHATNDP pushes a real 1 followed by a real 0 onto the NDP's internal register stack and divides 1 by 0. The result, stored in register ST(0), is positive infinity. It then copies the positive infinity to register ST(1) and generates a negative infinity in ST(0) by changing the sign with the FCHS instruction. Finally, it compares ST(0) and ST(1) with an FCOMPP instruction. If they're equal, then the infinity mode is projective (positive infinity and negative infinity are the same) and the coprocessor must therefore be a 287. However, if the two values are not equal, then the infinity mode is affine and the coprocessor must be a 387.

One thing to watch for is that if you run WHATNDP on a 486, it will tell you there's a 387 coprocessor installed. Of course there's really not. The 486 has an on-chip NDP built right into it that's architecturally similar to a 387. Obviously, if you run WHATCPU and find that there's a 486 installed, there's no need to even run WHATNDP.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your questions answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we're unable to answer questions individually. ■

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LOGGING IN TO NETWARE

When you're working on a Novell network with multiple servers, it's often convenient to log in to one server and attach to others you need to access. It's also nice to have just one login script to maintain. You can do this by choosing your main server and setting up your login script to use the ATTACH command to access other server volumes and print queues.

On the other servers, set up your login script to log you onto the server you chose as your primary machine. For example, if the main server is called billing, but accounting also has its own server, I'd set up my billing login script to ATTACH to accounting. And on the accounting server, I'd include the following "redirecting" line in the login script:

```
#f:\\public\\login billing
\my_login_name
```

This makes it easy to change login scripts, because you only have to keep the one on the main server current. It also adds consistency, because your environment doesn't change when you access resources on other servers. With the redirecting login script on all other servers, it is no longer necessary to specify your main server when you type your login name.

Adam Greene
Larchmont, New York

Judging from the amount of mail we get concerning the design and maintenance of *NetWare* login scripts, mastering them is an important part of a *NetWare* system administrator's job. Redirecting the login action is a dandy trick, particularly if varying network loads make it unclear which server will grab a client station's login attempt first.

LONG-DISTANCE LANS

Your review of X.25 LAN gateway products in the May 15, 1990, issue of *PC Magazine* described several ways to link LANs separated by many miles. But the article left open the question of what transmission speed you need to use to link the networks together in a satisfactory manner. The transmission rate relates directly to the cost of the modems and leased services. We just got a quote of over $300 per month for a 19.2-kilobit-per-second leased line between Los Angeles and Chicago. Because these services are quite expensive, would you please give us some idea as to how much speed is enough.

Mark Bundy
Los Angeles, California

High-speed long-distance circuits and high-speed X.25 services carry correspondingly high price tags, so you need to strike a fine balance between paying for too much service and suffering from too much delay in the links between LANs.

When you estimate the amount of data you will move across the LAN links, you can't simply look at the size of the files. For example, on a *NetWare*-based LAN, IPX adds a 30-byte header containing its control information. This means that if your application needs to send a 10 byte query to a server on a remote LAN, 40 bytes actually move across the link. On larger file transfers, IPX breaks the data into 512-byte packets and then adds its overhead to each packet.

Vendors of bridges and routers add their load on the transmission path by using special protocols to provide error detection and correction. HDLC, a commonly used router protocol, adds 2 leading bytes and 2 trailing bytes to each packet it carries across the long-distance link.

I contacted Newport System Solutions, a company with a lot of expertise in linking LANs, for help in "sizing" the communications line between networks.

The technical support people at Newport System Solutions pointed out that it isn't uncommon for sophisticated database programs to access 100K of index and key records to find a specific entry. So even if you think you're making a simple query into the database on a distant LAN, your query can move a large amount of data across the link.

Let's examine an exchange that sends a 100-byte query to a database on a distant network in order to receive a 1K reply. The total elapsed time for the communications portion of this exchange at a signaling rate of 9.6 kilobits per second is about 1 second. If a second person sends a similar query at the same time, in the worst case the reply of each user could take 2 seconds.

But it's more typical for 10 or 20 users to try to share the same link. Twenty people executing the same kind of queries on a 9.6-kilobit link could expect a 20-second response time for each query, supposing a nearly instantaneous response from the database file server. Today, few users would be happy with a 20-second response time. If you pay the considerable cost to increase the link speed to 56 kilobits per second, those 20 people would experience response times of about 3.5 seconds.

An alternative to installing faster lines is to install more of the slower-speed lines.

A single user can't benefit from two lines, but modern routers will split the user load between all available lines.

The cost of communications lines includes both a monthly recurring charge as well as the nonrecurring charge you will have to pay for installation and equipment. The deregulation of the long-distance telephone industry created a confused market. You'll find that you can get a wide variety of quotes for the same service from different companies.

The large long-distance carriers now sell package deals, giving you "virtual" leased lines instead of dedicated connections, and this can significantly reduce the monthly line charges. This service uses their lines on a demand basis instead of dedicating channels. This way the company has more flexibility, and it gives you lower rates. AT&T calls this service the Software Defined Network. The other long-distance carriers offer a similar service.

Because of the significant up-front cost of modems and line termination equipment, you should consider either initially leasing this equipment or buying the modems capable of faster service even if you start with slower-speed lines.

And, by the way, you should note that Microsoft's *LAN Manager* product is optimized for larger packets than *NetWare*, so if long-haul LAN linking is critical to your organization, *LAN Manager* deserves strong consideration.

LOADING VAPS

Here's a quick tip in response to the "Remote Control" item in the June 26, 1990, column. You can avoid the "LOAD VAP" message in *NetWare*, Versions 2.15 and later, by generating a file called SERVER.CFG in the SYS:SYSTEM directory. Entering the line:

```
VAP WAIT 10
```

in SERVER.CFG allows the LAN administrator 10 seconds to press a key and abort the loading of any VAPs. Unfortunately, this action stops the loading of any VAPs in the SYS:SYSTEM directory. The entire VAP issue becomes null and void in *NetWare 386*, where *NetWare* Loadable Modules (NLMs) replace the VAPs. You can load or unload NLMs at will while the system is operating.

Thanks for all the tips you've given me in this great column. Perhaps this will help other *NetWare* administrators.

Jeff Strickland
Charlotte, North Carolina

Only a few companies produce value-added process products for Novell *Advanced NetWare 286*, while at the same time the LAN Labs' mailbox overflows with *NetWare* Loadable Modules for *NetWare 386*. Since *Advanced NetWare 286* is the staple of the industry, and considering that relatively few organizations use *NetWare 386*, I think this indicates that NLMs are a lot easier to write than VAPs.

> The large long-distance carriers now sell package deals, giving you "virtual" leased lines instead of dedicated connections, and this can significantly reduce the cost of monthly line charges.

At the present time, most of the NLMs fall into one of two categories: printer accessories and statistics-gathering software. Version 3.1 of *NetWare 386* includes more tools that are used to develop NLMs, so I think we'll be seeing even more NLM products on the market in the future. Now if folks would just start buying *NetWare 386* . . . .

SAVING YOUR PATH IN NETWARE, ROUND 2

Michael LeBlanc's letter in the July 1990 Connectivity column brought up a nagging issue for many Novell *NetWare* network administrators: How do you create a login script that won't overwrite the path setup on the computer's boot disk? *PC Magazine* provided one solution, but I've found that it isn't the easiest alternative. Fortunately, there is a feature of the network search MAP command that allows a solution to the problem.

You can start your search drive mappings with a number greater than one and *NetWare* will leave environment space so that the drives previously defined in the DOS PATH will remain in the environment. So, for example, it is possible to declare your first search mapping with the number 8 instead of 1. This is accomplished by entering the following lines:

```
SEARCH 8:=SYS:APPS
SEARCH 9:=SYS:EMAIL
SEARCH 10:=SYS/UTIL/BATCH
```

In this way, you can have up to seven PATHed directories in the workstation's memory and your login script won't obliterate them. If there are fewer than seven directories in the PATH statement, *NetWare* will append its MAPped drives to the end of the DOS PATH list. You might find that you're wasting a little environment space, but it works!

Now, when you issue the naked MAP command from the system prompt, you'll see the DOS PATHed directories listed as search drives, followed by the *NetWare* directories and their corresponding search mappings.

It's important to make sure that you put a semicolon at the end of the PATH statement in the AUTOEXEC.BAT file of the workstation.

Steven K. Posner
Glendale, California

We have received several responses from readers in reply to the question of how to retain the DOS PATH after you have logged in to a *NetWare* server. The simple technique described above works nicely, as long as you don't have a long list of referenced drives and subdirectories.

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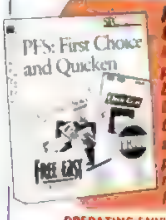

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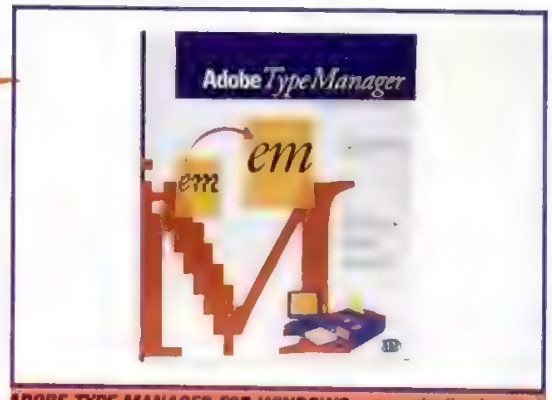

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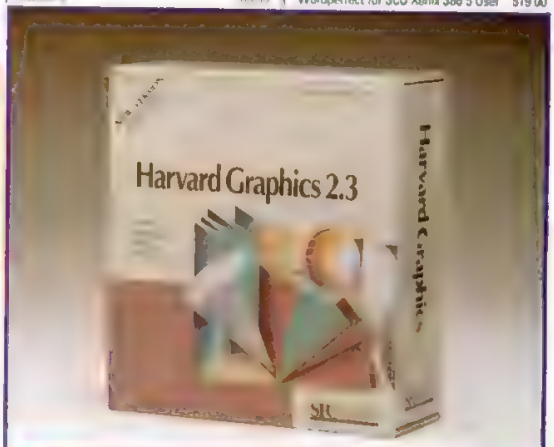

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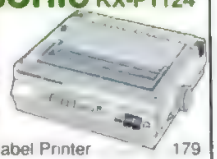

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XB2410 / 2415 ... 429 / 569

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Diamond Scan 1381 ... 479
NEC
Multisync 2a ... 489
Multisync GS 2a ... 199
Multisync 3d ... 629
Multisync 4d ... 1095
Panasonic
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Masterpeice Plus ... 95

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2400 ETC External ... 187
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VGA Wonder 512 ... 239
Brown Wagh Sound Blaster ... 157
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1200B Int Modem ... 55
2400B Int Modem ... 105
EGA 480 Card ... 79
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287XL New! ... 209
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387-SX16 ... 319
Logitech Scanman Plus ... 159
Orchid
ProDesigner ... 229
ProDesigner II 512 1mb ... 299/349
Tiny Turbo 286 ... 207
Tiny Turbo Xtra ... 267
Paradise
Basic VGA - 8 bit ... 109
VGA 1024 256K ... 175
VGA 1024 512K ... 229
Practical Peripherals
1200B Int Modem ... 59
2400B Int Modem ... 125
2400B Int with MNP ... 169
Prometheus
Promodem 1200B Int ... 48
Promodem 2400B Int. ... 98
Promodem 2400B Mini-Pocket ... 119
Promodem 2400G Ext. ... 149
The Complete PC
Answering Machine ... 239
Fax 4800 ... 229
Hand Scanner 400 ... 139
Tiara Networking
Lancard A PC (Arcnet) ... 79
Lancard E Star 8 (Ethernet) ... 139
Lancard E AT (16 bit Ethernet) ... 249
USRobotics
2400 Baud Internal ... 119
2400 Baud External ... 149
Courier HST 14,400 Ext. ... 579
Courier HST 14,400 Int. ... 539
Video 7
VGA 1024i 256K ... 209
VGA 1024i 512K ... 237
Vega VGA ... 149
V-RAM VGA 512K ... 355
Western Digital Controllers
WD1006V-MM2 MFM AT 1:1 ... 109
WD1006V-SR2 RRL AT 1:1 ... 129
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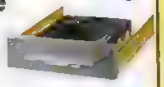

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Toshiba
360K Floppy ... 69
720K 3.5" Floppy ... 69
1.2MB 5.25" Floppy ... 79
1.44MB 3.5" Floppy ... 79

SOFTWARE

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Clarion Professional Developer ... Call
Clipper ... 399
DataEase ... 459
dBase III+ ... 419
dBase IV ... 479
dBXL Diamond ... 129
Foxbase Plus ... 179
FoxPro ... 417
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Reflex ... 159

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Generic Cadd Level 2 Starter Kit ... 109
Generic Cadd Level 3 ... 199
Harvard Graphics ... 275
Pagemaker ... 479
PC Paintbrush IV Plus ... 109
Perspective Jr ... 69
PFS First Publisher ... 89
Publisher's Paintbrush ... 149
Publish It! ... 104
Ventura Publisher Gold ... 519

FINANCIAL

Bedford Integrated Acct ... 145
DAC Accounting 4.0 ... 79
DAC Bonus Pack 4.0 ... 157
Dollars & Sense ... Call
Managing Your Money ... 113
Peachtree Complete III ... 139
Peachtree with Data Query ... 209
Quicken ... 35

INTEGRATED

First Choice ... 105
SmartWare II ... 417
Windows 3.0 ... 89
Works ... 89

MICE

Keytronics Professional ... 65
Logitech HiRes C9 Serial ... 65
Logitech HiRes C9 Bus ... 76
Logitech Trackman Serial ... 75
Microsoft Serial or Bus w/ paint ... 95
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Quick C ... 60
Quick Pascal ... 60

SPREADSHEETS

Allways ... 106
Excel ... Call
Lotus 1-2-3 version 2.2 ... 325
Lotus 1-2-3 version 3.0 ... Call
Lucid 3-D ... 53
Quattro Pro (call for details) ... 89

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UTILITIES

Control Room ... 69
CoreFast ... 60
Carbon Copy Plus ... 109
Desqview ... 68
Desqview 386 ... 115
Direct Access ... 46
Fastback Plus ... 109
Formtool Gold ... 52
Formfiller ... 85
Headroom ... 59
Laplink III ... 85
MS-Dos 3.3 or 4.01 ... 59
Mace Utilities 1990 ... 79
Norton Advanced ... Call
PC Anywhere III ... 59
PC Tools Deluxe 6.0 ... Call
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Ami (WP) ... 115
Ami Professional (WP) ... 287
Asymetrix Toolbook ... 279
Corel Draw (GR) ... 309
DBfast Windows (DB) ... 189
Excel (SS) ... 299
Grammatik IV for Windows (WP) ... 49
PC Paintbrush for Windows (GR) ... 77
Pagemaker (DP) ... 479
Micrographix ... Call
Microsoft Mouse w/ Windows 3.0 ... 147
Windows 3.0 ... 89
WingZ for the PC (SS) ... 309
Word for Windows (WP) ... 309

WORD PROCESSORS

GEM First Word Plus ... 52
Grammatik IV ... 49
Multimate 4.0 ... 267
Professional Write ... 149
Rightwriter ... 45
Sprint ... 117
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DesignCAD V3.0 3D 188

CD-ROM
Microsoft Bookshelf 189
Nec Clip Art 3D (PC).....239

COMMUNICATIONS
Crosstalk XVI V3.7. 103
PCanywhere III V3.11.....58
Procomm Plus V1 1B 47

DATABASE
Clipper 409
dBase IV V1.0..... 459
DBXL V1.3 132
Foxbase+ Dev V2 1 179
Paradox V3.0 439
R Base V3.0 499

DESKTOP PUBLISHING
Pagemaker V3.0 489
Ventura Pub V3.0 Gold 509
PFS First Pub V3.0 85
Finesse 3.1 - Logitech 85

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Microsoft Learning DOS V2.0 33
PC GLOBE 3.0 37
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FINANCE
Quicken V3.0 34
Managing Your Money V6.0 112
Wealthbuilder 132

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FORMS
Formgen Plus V5.0 129
Formaker II W/HP Fonts 225
Form Publisher for Windows 149
Formworx with Fill & File 79
Formtool V2.01 49
PerFORM V2.1 *new!*.....155

GRAPHICS
PC Paintbrush IV Plus 105
Adobe III for Windows 298
Corel Draw V1 2 313
Autodesk Animator 229
Designer V3.0 455
Harvard Graphics V2 13 285

INTEGRATED
Microsoft WORKS V2.0 92
PFS First Choice 98
Q&A V3.0 229

OPERATING ENVIRONMENTS
Desqview 386 V2.2.....110
Microsoft Windows V3.0 89
Toolbook for Windows 279

PROGRAMMING
Turbo C Pro Pack ..... .159
Turbo Pascal V5.5.....95
Microsoft Quick Basic V4.5 61
Microsoft Quick C V2.5.....61

PROJECT
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SuperCalc 5 289

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BACKUP
BACK IT 55
Fastback Plus V2.1 98
Norton Backup 89
PC Fullback Plus.....47
GENERAL
Copy II PC Plus V9.....22
Mace Vaccine.....53
Norton Editor V1.3C 45
HARD DISK
CheckIt 79
Disk Optimizer V4.05 37
Mace Utilities V1990 79
Norton Util Adv V4.5 89
Disk Technician Adv V6.0 89
PC Tools V6.0 79
Spinrite II V1 1 67
LAPTOP
Battery Watch V2.0 27
Brooklyn Bndge V3.0.....75
LAP-LINK 85
MEMORY
AboveDisc V4.0 59
PopDrop Plus 55
QEMM V5.0 386 53
MENU
Direct Access V5.0 53
XTREE Pro Gold V1 4 69

OCR
Read-It.....69
ReadRight Personal..... 165
PRINT
GoScript Plus V3.0 175
PrintQ V4.0 71
Sideways V3.2 37
UltraScript PC 2.0 105

WORD PROCESSING
Microsoft WORD V5.0 209
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PFS Pro Write V2 2 149
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HSP 550 300 CPS 136 Col 449
Kodak
Diconix 150 PLUS - Par 339

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P6300 136 Col/24 Pin 659
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ML 380 9 pin 299
ML390-Plus 9 pin 459
ML391-Plus 9 pin 635
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JetMemory 1MB P/II 165
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25-In-1 III 335
PacificPage P / III.....359/479
Plotter-In-A-Cart II 239

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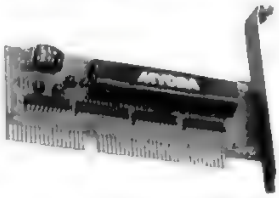

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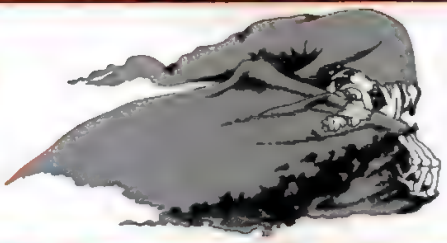

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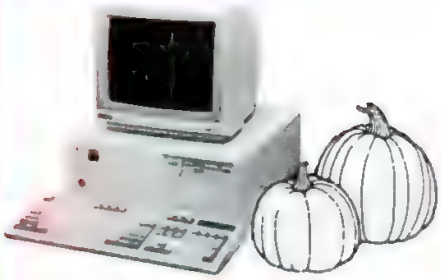

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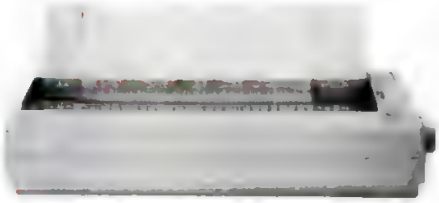

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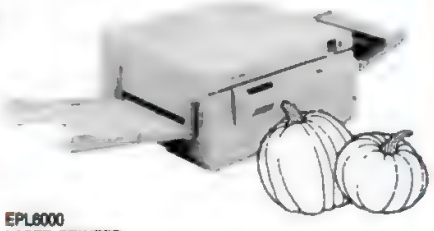

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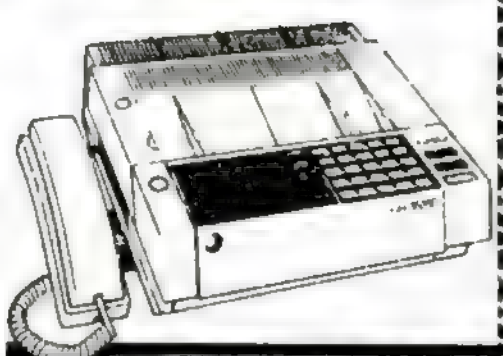

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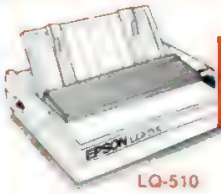

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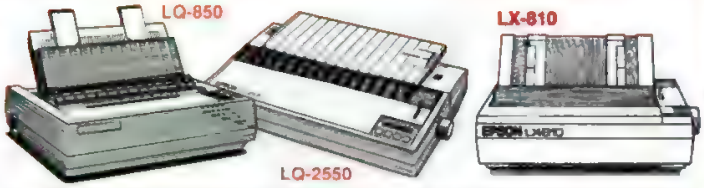

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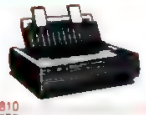

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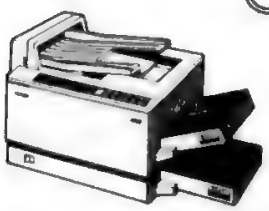

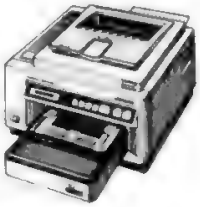

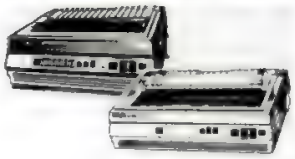

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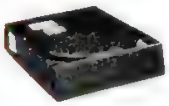

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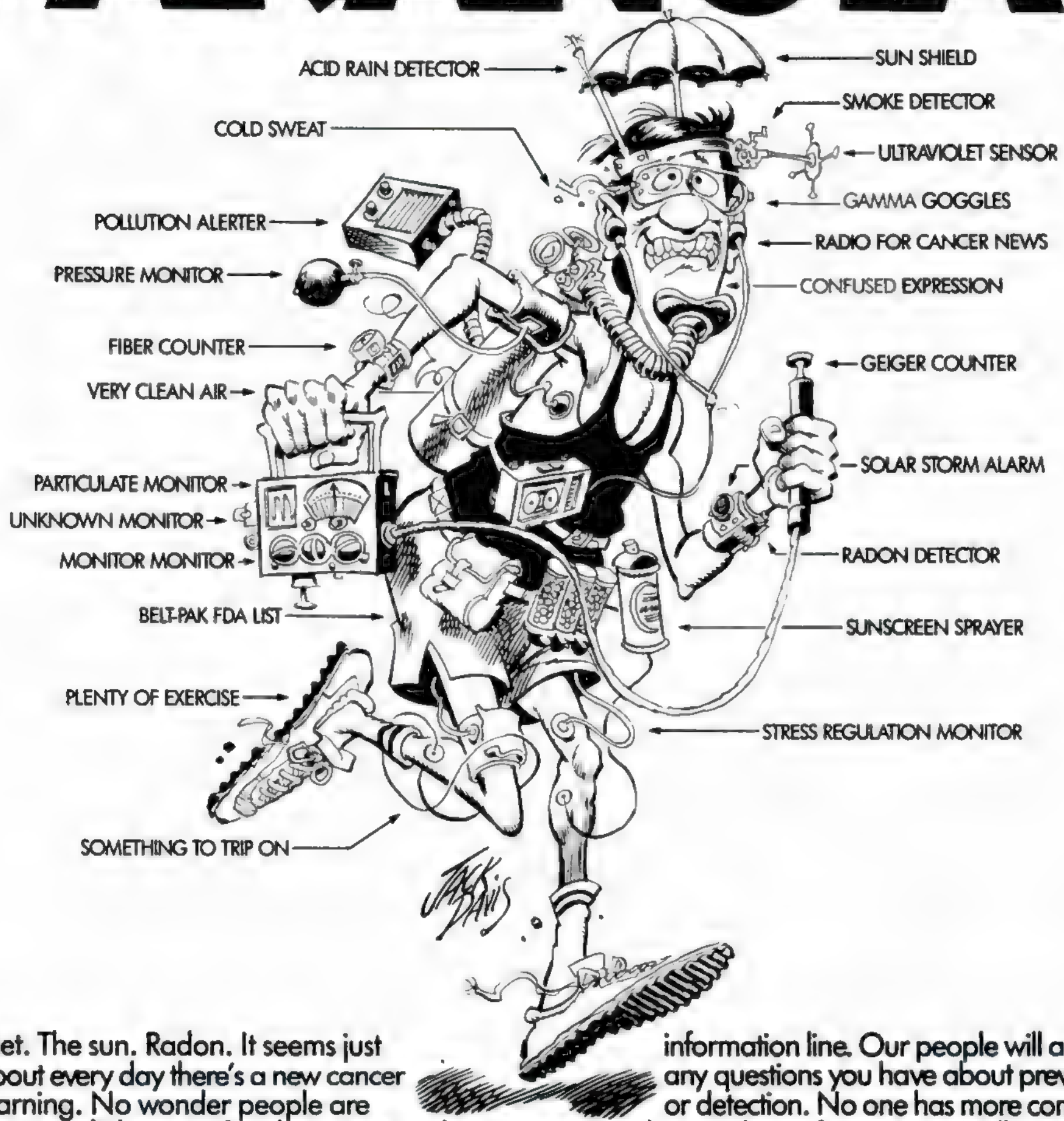

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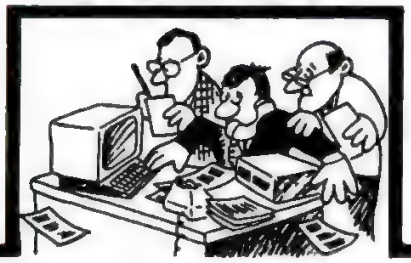

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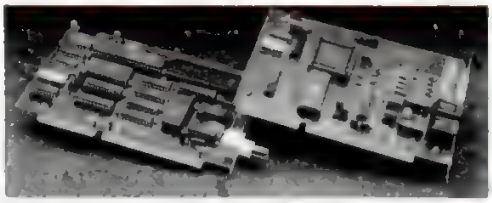

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03 ☐ Networked together

7. Please check the equipment currently installed at your location: (Check all that apply.)
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8. Do you plan to buy any PC Products?
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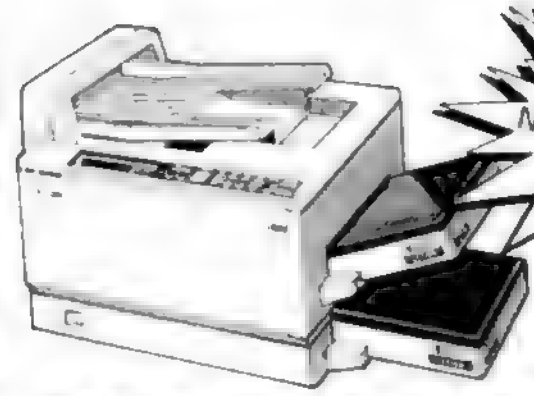

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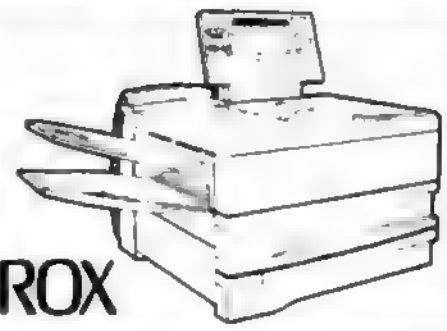

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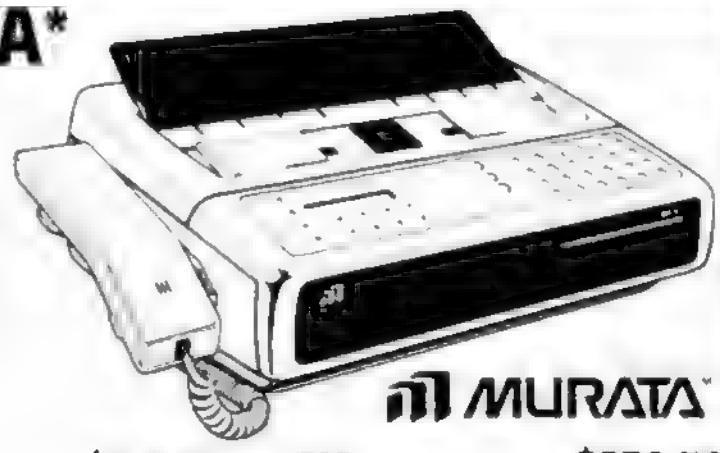

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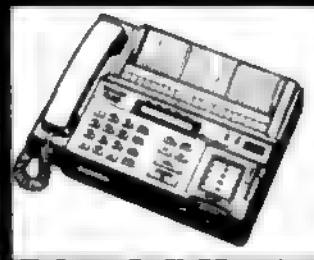

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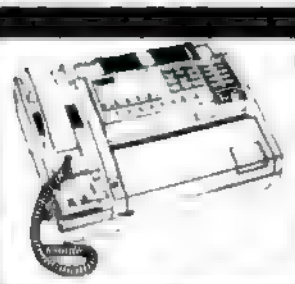

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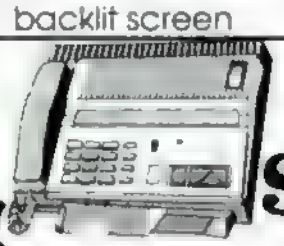

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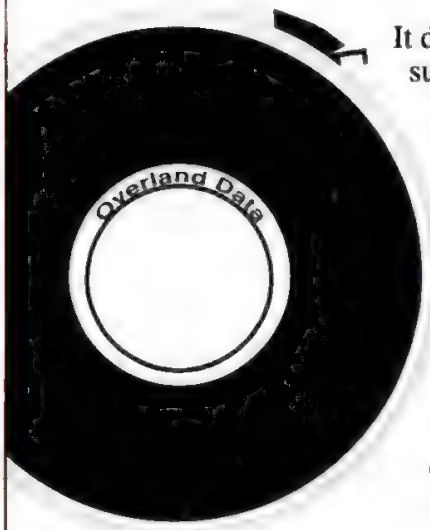

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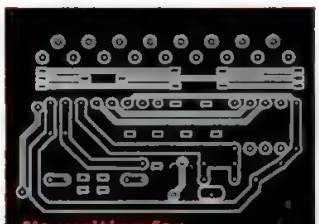

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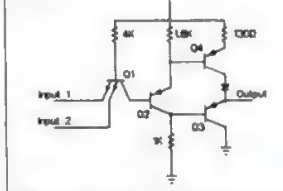

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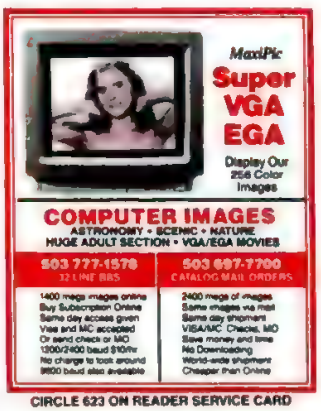

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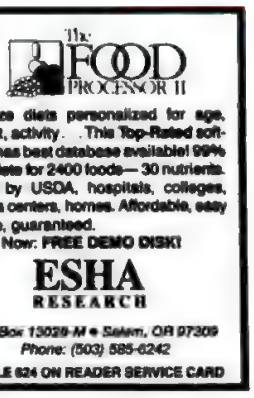

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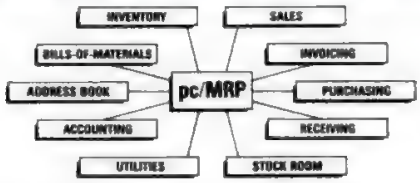

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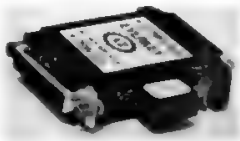

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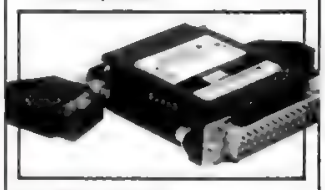

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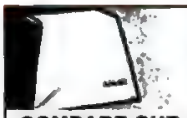

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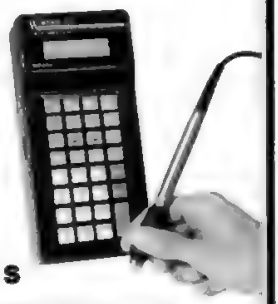

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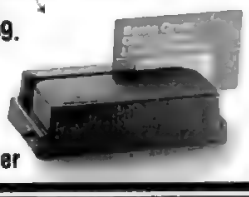

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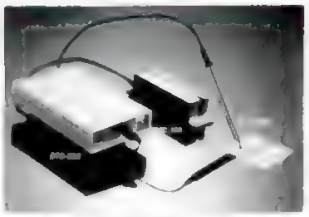

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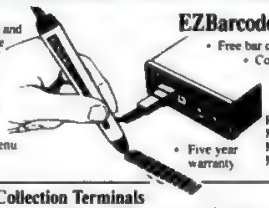

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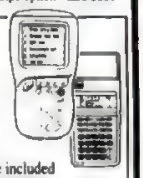

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ADVERTISERS PRODUCT INDEX

RS#	ADVERTISER	PRODUCT	PAGE#
ACCOUNTING SOFTWARE			
375	Computer Associates	ACCPAC	448
502	DAC Easy, Inc.	ACCOUNTING SOFTWARE	75
263	Macola Inc.	ACCOUNTING SOFTWARE	328
358	Peachtree Software	ACCOUNTING SOFTWARE	463
DATABASE MANAGERS			
•	Ashton Tate	DBASE IV 1.1	170-171
287	Borland International	PARADOX	476
•	Oracle	DATABASE SOFTWARE	80
199	XTREE-Div of Executive Systems	X-TREE PROGOLD	485
INFORMATION MANAGERS			
•	Lotus Development	AGENDA	39
LANGUAGES			
•	Microsoft	QUICK C / ASM	460
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
OPERATING SYSTEMS/ENVIRONMENTS			
272	DSC Communications	DSC NEXOS	481
•	Mark Williams	OPERATING SYSTEM	68
•	Microsoft	WINDOWS COMPUTING	305
•	Microsoft	WINDOWS 3.0	2-3
269	Stika Corp (Formerly TOPS)	DOS BUNDLE	251
724	Softlogic Solutions	SOFTWARE CAROUSEL	14
393	Software Link	PC MOS	442
PROGRAM DEVELOPERS/GENERATORS			
329	Borland International	TURBO C/C++	57
PROJECT MANAGEMENT			
148	Primavera Systems	PROJECT MANAGEMENT SOFTWARE	459
STATISTICAL SOFTWARE			
365	STSC	STATISTICS SOFTWARE	455
TEXT EDITORS			
236	Fifth Generation	MACE UTILITIES	325
UTILITIES			
131	Bitstream	FaceLift	197
328	Buffalo Products	PRINTING UTILITY	224
749	Central Point Software	PC TOOLS DELUXE	70-71
286	Fifth Generation	THE BROOKLYN BRIDGE	293
236	Fifth Generation	MACE UTILITIES	325
232	Fifth Generation	FAST BACK PLUS	271
224	Franklin Software	LANGUAGE MASTER	86
167	Helix Software	HEADROOM 2.0 VERSION	51
156	Isogon Corp	FONTSPACE	21
•	Lotus Development	MAGELLAN	263
170	Multisoft Corporation	SUPER PC KWIK	220
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
140	PC Publishing	ADD ON UTILITY BUNDLED W/1-2-3	59
302	Peter Norton Computing	NORTON UTILITIES 5.0	209
724	Softlogic Solutions	SOFTWARE CAROUSEL	14
204	Traveling Software	LAPLINK	150
199	XTREE-Div of Executive Systems	X-TREE PROGOLD	485
WORD PROCESSING SOFTWARE/AIDS			
250	Corel Systems/Samna	AMI PROFESSIONAL	202
232	Fifth Generation	FAST BACK PLUS	271
224	Franklin Software	LANGUAGE MASTER	86
325	IQ Engineering	IQ SUPER CARTRIDGE	92
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
•	Software Publishing	WORD PROCESSING PACKAGE	469
•	Wordperfect	WORD PROCESSING SOFTWARE	96
518	Xyquest	WORD PROCESSING	86
CAD/CAM			
506	Generic Software	AUTOSKETCH	285
154	MathSoft Inc.	PC CAD V 2.5	67
SPREADSHEET/TEMPLATES			
285	Borland International	QUATTRO PRO	482
323	Funk Software	PDQueue	174
325	IQ Engineering	IQ SUPER CARTRIDGE	92
•	Lotus Development Corporation	123 3.1	400-401
•	Lotus Development	123 FOR UNIX SYSTEM V	486
•	Microsoft	WINDOWS EXCEL	445
140	PC Publishing	SPREADSHEET	59
DESK TOP PUBLISHING			
250	Corel Systems/Samna	AMI PROFESSIONAL	202
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
299	SWFTE International, Ltd.	GLYPHIX	37
175	Ventura Software, Inc.	XEROX VENTURA	489
DATA ENTRY SOFTWARE			
362	OCR Systems	READ RIGHT	149
FORM DESIGNERS			
380	Bloc Publishing	FORM FILLER 3.0	74
250/734	Delrina Technology	PerFORM PRO	140
257	Indigo Software Ltd.	ELECTRONIC FORMS SOFTWARE	108
PRE-PRINTED FORM SOFTWARE			
380	Bloc Publishing	FORM FILLER	74
FONT SOFTWARE			
131	Bitstream	FaceLift	197
156	Isogon Corp.	FONTSPACE	21
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
FLOWCHARTING			
301	Patton & Patton	FLOW CHART SOFTWARE	94
124	Roykore, Inc.	ABC FLOWCHARTER	475
WINDOWS SOFTWARE			
•	Adobe Systems	ATM WINDOWS	333
305	GUI Cleaning House	MAIL ORDER	470
528	hDC Computer Corporation	HDC WINDOWS EXPRESS	203
•	Microsoft	WINDOWS COMPUTING	305
•	Microsoft	WINDOWS 3.0	2-3
•	Microsoft	WINDOWS EXCEL	445
124	Roykore, Inc.	ABC FLOWCHARTER	475
COMPATIBLE KEYBOARDS			
179	Jameco Electronics	MAIL ORDER	474
•	Northgate Computer Systems	KEYBOARDS	232-233
388	Zeos International	KEYBOARD	78
BACKUP SOFTWARE			
232	Fifth Generation	FAST BACK PLUS	271
DISK BACKUP & TAPE DRIVES			
749	Central Point Software	PC TOOLS DELUXE	70-71
473	Colorado Memory Systems, Inc.	STORAGE-JUMBO TAPE BACKUP	316
198	Core International	DISK BACKUP & TAPE DRIVES	198
169	Lyben Computer Systems	3M DATA CARTRIDGE TAPES	336
495	Maynard Electronics	DAT	337
317	Megadrive Systems, Inc.	REMOVABLE HARD DISK DRIVES	146
240	Mountain Computer Inc.	FILESAFE-BACK UP SYSTEM	26
190	Procom Technology	STORAGE PERIPHERALS	222
•	Seagate	WREN DISK DRIVES	273
377	Sony Magnetic Products Co	DATA CARTRIDGES	298-299
268	SWAN Technologies	TAPE BACK-UPS	22-25
384	Tecmar	MASS STORAGE, TAPE DRIVES	128-129
HARD DISKS			
198	Core International	20 MHZ DRIVE	198
244	IEF	DISK PACK	315
317	Megadrive Systems, Inc.	REMOVABLE HARD DISK DRIVES	146
190	Procom Technology	STORAGE PERIPHERALS	222
161/314	Storage Dimensions	LASER STORAGE & ERASABLE WRITE	358
COMPUTERS/COMPATIBLES			
129	Acma Computers, Inc.	ACMA PC'S	40-41
165	Advanced Logic Research	BUSINESS VEISA	32
111	Arche Technologies	ARCHE PC'S	145
166	AST Research	PC'S	136-137
•	Austin Computers	PC'S	10-11
509	Austin Computers	MAIL ORDER, PC'S	12-13
109	Comp. Discount Warehouse (MMC)	COMPATIBLES	518-519
•	Compaq Computer Corporation	PC'S	377-380
•	Compaq Computer Corporation	PC'S	362-363
•	CompuAdd	316S	241-244
•	CompuAdd	320S	493-496
387	COMPUTERLAND	EPSON PC	266-267
372	Copam U.S.A., Inc.	COPAM PC'S	335
•	Dataworld	PC'S	18-19
532	Dell Computer Corporation	DELL PC'S	177-190
479	Ergo Computing Inc.	PC	132-133
113	Everex / Computer Info Special	486 SYSTEMS	440-441
•	EXCEL MICRO	COMPUTERS/COMPATIBLES	518
•	Gateway 2000	COMPATIBLES	113-124
•	Hewlett Packard Vectra	HEWLETT PACKARD VECTRA'S PC's	64
525	Hyundai	PC'S	212-213
•	IBM Corp.	PS/2	200-201
•	IBM Corp.	RISC6000	110-111
480	Iverson Computer Corporation	CUSTOM DESIGNED PC'S	96-97
179	Jameco Electronics	MAIL ORDER	474
157	NEC Technologies Inc.	BUSINESSMATE	60-61
•	Northgate Computer Systems	COMPATIBLES	415-417
•	Northgate Computer Systems	COMPATIBLES	419-421
•	Northgate Computer Systems	COMPATIBLES	228-235
•	Northgate Computer Systems	COMPATIBLES	423
•	Northgate Computer Systems	COMPATIBLES	405
•	Northgate Computer Systems	COMPATIBLES	407
•	Northgate Computer Systems	COMPATIBLES	409
•	Northgate Computer Systems	COMPATIBLES	413
•	Northgate Computer Systems	COMPATIBLES	411
271	Pao-Ku Ltd.	COMPATIBLES	513
303	PC Brand	PC'S	348-357
238	Premier Innovations	PC'S	84
326	Sears Business Centers	AT&T 6386 SX/EL	223
163	Standard Computer Corp.	PC'S	52-53
135	Sun Microsystems	SPARKSTATION IPC	389
268	Swan Technologies	COMPUTERS	22-25
284	Tandon Computer Corporation	COMPUTERS	163-166
312	Tandon Computer Corporation	COMPUTERS	287-290
508	Tandon Computer Corporation	COMPUTERS	369-372
391	Tangent Computer, Inc.	PC'S/SYSTEMS	107
123/206	Telemart	PC'S	88-91
306	Tenex Computer Express	MEMORY PRODUCT	522
121	Tri-Star Computer	COMPUTERS/COMPATIBLES	17
385	US Integrated Technologies	USIT PC'S	193
184	Wyse Technology	COMPATIBLE PC'S	62
211	Xircom	ETHERNET ADAPTER CARDS FOR LAP	340
732	Zenith Data Systems	COMPATIBLES	424
721	Zeos International	COMPATIBLES	216-217
487	Zeos International	COMPATIBLES	76-77
115	Zeos International	Z-CARD	437
388	Zeos International	KEYBOARD	78
•	Zeos International	ZEOS' NOTEBOOK LAPTOP	48A-H
•	Zeos International	COMPATIBLES	429-436
INPUT DEVICES			
501	CH Products	ROLLERMOUSE	248
492	Kye International	MOUSE	249
182	Logitech	MOUSE SERIES 9	253
343	Logitech	TRACKMAN	255
PROGRAMMERS TOOLS UTILITIES			
•	Ashton Tate	CONTROL ROOM	345
329	Borland International	TURBO C/C++	57
ADD-ON BOARDS			
128	Capital Equipment Corporation	ADD IN BOARDS	450
374	Intel	(PCEO) NET BOARD	54
325	IQ Engineering	IQ SUPER CARTRIDGE	92
370	Micron Technology	ADD ON BOARD,MEMORY BOARD	402
327	Paradise	VGA BOARDS	268
268	SWAN Technologies	VGA BOARDS	22-25
•	Truevision Inc.	VIDEO GRAPHICS BOARD	319
SCANNERS/DIGITIZERS			
492	Kye International	SCANNER	249
492	Kye International	DIGITIZER TABLET	249
359	Our Business Machines, Inc.	GRAY SCALE SCANNER	4

RS#	ADVERTISER	PRODUCT	PAGE#
PRINTERS			
328	Buffalo Products	PRINTING UTILITY	224
187	Canon, USA	LASER BEAM PRINTERS	451
155	Canon, USA	BUBBLE JET 10e	173
367	COMPUTERLAND	EPSON PRINTER	266-267
363	Eastman Kodak	DICONIX 150 PLUS PORTABLE	457
325	IQ Engineering	IQ SUPER CARTRIDGE	92
179	Jameco Electronics	MAIL ORDER	474
•	NEC Technologies, Inc.	P6300 DOT MATRIX PRINTER	246
245	Output Technology	850 DOT MATRIX PRINTER	127
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
138	Panasonic	OA LASER PRINTER	297
122	Panasonic	OA LASER PRINTERS	154
259	QMS	PRINTERS	5
FLOPPY DISK DRIVES			
190	Procom Technology	STORAGE PERIPHERALS	222
FONT CARTRIDGES			
125	Intercon	FONT CARTRIDGES	69
TRACK BALLS			
501	CH Products	ROLLERMOUSE	248
PRINTER ACCESSORIES			
521	3M Memory Technologies	3LC LASER/COPIER LABELS	322
328	Buffalo Products	PRINTING UTILITY	224
150	Dresselhaus Computer Products	PRINTER SHARING DEVICES	225
•	Epson	PRINTER	258-259
286	Fifth Generation	THE BROOKLYN BRIDGE	293
•	Hewlett Packard-Peripheral Gp.	GALAXY PRINTER	194-195
325	IQ Engineering	IQ SUPER CARTRIDGE	92
726	Kansai International	PRINTER SHARING DEVICE	16
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
290	Rose Electronics	PRINTER SHARING	412
304	Texas Instruments	MICROLASER	499
PORTABLE/LAP COMPUTERS			
203	Bondwell	BONDWELL LAPTOPS	473
273	Bus Computer	LT-386SX	159
•	CompuAdd	LAPTOP	241-244
•	CompuAdd	LAPTOP	493-496
183	D-Link Systems, Inc.	POCKET LAN ADAPTER	143
212	Dolch Computers	DOLCH P.A.C.	29
•	NEC Technologies, Inc.	386SX 20	397
271	Pao-Ku Ltd.	LAPTOPS	513
312	Tandon Computer Corporation	LAPTOP	287-290
289	Tandy Corporation	LAPTOP	339
177	Texas Instruments	LAPTOP	169
379	Toshiba of America	LAPTOP	104-105
211	Xircom	ETHERNET ADAPTER CARDS FOR LAP	340
732	Zenith Data Systems	LAPTOP COMPUTERS	424
•	Zeos International	ZEOS' NOTEBOOK LAPTOP	48A-H
PC-FAX			
234	3X USA Flyp96	FAX BOARD	47
CO-PROCESSORS			
747	Cyrix Corp	MATH CO-PROCESSOR	161
OPTICAL PERIPHERALS			
190	Procom Technology	STORAGE PERIPHERALS	222
161/314	Storage Dimensions	LASER STORAGE & ERASABLE WRITE	358
MEMORY SUBSYSTEMS			
190	Procom Technology	STORAGE PERIPHERALS	222
306	Tenex Computer Express	MEMORY PRODUCT	522
OS/2 SOFTWARE			
305	GUI Clearing House	MAIL ORDER	470
TIME MANAGEMENT SOFTWARE			
105	Campbell Services Inc	CALENDARING SOFTWARE	479
CD-ROM			
190	Procom Technology	STORAGE PERIPHERALS	222
CHIPS/PROCESSORS			
•	Intel Corporation	MATH CO PROCESSOR	465
DISPLAYS/MONITORS/TERMINALS			
153	NEC TECHNOLOGIES, INC.	MultiSync Monitors	2-4
490	Seiko Instruments	MONITOR	42
294	Tatung Company of America	MONITORS	490
GRAPHICS SOFTWARE			
729	Corel Systems/Samna	COREL DRAW	226
•	Micrografx	DESIGNER	72
362	OCR Systems	READ RIGHT	149
PLOTTERS/CHARTING DEVICES			
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
VIDEO GRAPHICS/BOARDS			
540	ATI Technologies Inc.	9600 EXTERNAL MODEM	256
118	Hercules Computer Technology	GRAPHICS BOARDS	265
370	Micron Technology	VIDEO PRODUCTS	402
153	NEC Technologies, Inc.	MultiSync Graphics Board	2-4
327	Paradise	VGA BOARDS	268
•	Truevision Inc.	VIDEO GRAPHICS BOARD	319
COMMUNICATIONS SOFTWARE			
328	Buffalo Products	PRINTING UTILITY	224
749	Central Point Software	PC TOOLS DELUXE	70-71
504	DATASTORM Technologies Inc.	PROCOMM PLUS	227
278	DCA	CROSSTALK	20
286	Fifth Generation	THE BROOKLYN BRIDGE	293
213	Norton Lambert	COMMUNICATIONS SOFTWARE	87
204	Traveling Software	LAPLINK	150
LOCAL AREA NETWORKING			
293	3 COM 3+	OPEN SERVER	374-375
328	Buffalo Products	PRINTING UTILITY	224
483	ConnectWorks	LAN	398
185	CONNEXPERTS	SYSTEMIZER	324
183	D-Link Systems, Inc.	POCKET LAN ADAPTER	143
272	DSC Communications	DSC NEXOS	481
146	Gateway Communications	ETHERNET BOARD	393
•	IBM Lan Marketing	TOKEN RING ADAPTER CARD	366-367
322	Novell Data Systems	NOVELL NETWORKING PRODUCTS	326-327
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
290	Rose Electronics	PRINTER SHARING	412
326	Sears Business Centers	AT&T 6386 SX/EL	223
230	US Sage	MAIN LAN	361
211	Xircom	ETHERNET ADAPTER CARDS FOR LAP	340

RS#	ADVERTISER	PRODUCT	PAGE#
MICRO-MAINFRAME LINKS			
296	Attachmate EXTRA!	EXTENDED	385
MODEMS			
337	ATI Technologies Inc.	VGA WONDER PLUS	394
179	Jameco Electronics	MAIL ORDER	474
231	Touchbase Systems MNP	MODEMS	28
367	Universal Data Systems V 32	MODEM	502
EMULATORS/PROTOCOL CONVERTERS			
241	Pacific Data Products	PACIFIC PAGE	239
297	Pacific Data Products	25 IN 1	264
MULTIUSER SYSTEMS			
230	US Sage	MAIN LAN	361
PERIPHERAL SHARING DEVICE			
328	Buffalo Products	PRINTING UTILITY	224
101	Verran AC	DATALINK	365
DISKETTES			
•	Maxell RD SERIES	FLOPPY DISKS	306
377	Sony Magnetic Products Co	FLOPPY DISKS	298-299
223	Verbatim	DISKETTES	95
POWER PROTECTION			
378	Iomega Corporation	BERNOULLI BOX	204-205
267	Powercard Supply	INTERNAL BACK-UP POWER	454
SECURITY			
267	Powercard Supply	INTERNAL BACK-UP POWER	454
PC ACCESSORIES			
•	Curtis Manufacturing	ACCESSORIES	103
220	Kensington Microware Ltd.	PC ACCESSORIES	427
169	Lyben Computer Systems	3M DATA CARTRIDGE TAPES	336
RETAIL/DISTRIBUTORS			
326	Sears Business Centers	AT&T 6386 SX/EL	223
MAIL ORDER			
129	Acma Computers, Inc.	ACMA PC'S	40-41
336	Arlington Computer Products	MAIL ORDER	507
•	Austin Computers	MAIL ORDER	10-11
509	Austin Computers	MAIL ORDER, PC'S	12-13
141-481	Bulldog Computer Products	MAIL ORDER SYSTEMS/PRINTERS	514/515
109	Comp. Discount Warehouse (MMC)	MAIL ORDER	518-519
205	Compuclassics	MAIL ORDER	506
300	Computability	MAIL ORDER	523
•	Damark International	MAIL ORDER	517
532	Dell Computer Corporation	DELL PC'S	177-190
347	Duston Discount Software	MAIL ORDER SOFTWARE	156
•	EXCEL MICRO	COMPUTERS/COMPATIBLES	516
352	FASTMICRO	MAIL ORDER	508-509
•	Gateway 2000	COMPATIBLES	113-124
305	GUI Clearing House	MAIL ORDER	470
•	Hard Drives International	MAIL ORDER	521
179	Jameco Electronics	MAIL ORDER	474
•	Lyben Computer Systems	3M DATA CARTRDIGE TAPES	68
307	Micro National	MAIL ORDER	510
225	MicroWarehouse Inc	MAIL ORDER	310-313
489	Midwest Computer Works	MAIL ORDER	520
•	Northgate Computer Systems	COMPATIBLES	415-417
•	Northgate Computer Systems	COMPATIBLES	419-421
•	Northgate Computer Systems	COMPATIBLES	228-235
•	Northgate Computer Systems	COMPATIBLES	423
•	Northgate Computer Systems	COMPATIBLES	405
•	Northgate Computer Systems	COMPATIBLES	407
•	Northgate Computer Systems	COMPATIBLES	409
•	Northgate Computer Systems	COMPATIBLES	413
•	Northgate Computer Systems	COMPATIBLES	411
271	Pao-Ku Ltd.	MAIL ORDER	513
303	PC Brand	M/O	348-357
•	PC Connection	MAIL ORDER	276-281
295	RP Systems	MAIL ORDER	512
349	S & W Computers	MAIL ORDER	524-523
127	Softbank	MAIL ORDER	236
268	Swan Technologies	MAIL ORDER	22-25
123/206	Telemart	MAIL ORDER	88-91
306	Tenex Computer Express	MAIL ORDER	522
171	Warehouse Data Products	MAIL ORDER	511
721	Zeos International	COMPATIBLES	216-217
115	Zeos International	Z-CARD	437
388	Zeos International	KEYBOARD	388
•	Zeos International	ZEOS' NOTEBOOK LAPTOP	480-487
•	Zeos International	COMPATIBLES	429-436
ON LINE DATABASES			
207	CheckFree Technology Inc.	ON LINE CHECK CASHING SERVICE	458
226	CompuServe Information Service	ON-LINE SERVIVE	346
137	CUC International COMPU-STORE	ON-LINE SERVICE	522
497	PC MagNet	ON LINE DATABASE	505
BOOKS			
172	Abacus	COMPUTER BOOKS	301
UNIX PRODUCTS			
•	Lotus Development	123 FOR UNIX SYSTEM V	486
•	Mark Williams	UNIX PRODUCT	68
MISCELLANEOUS			
172	Abacus	COMPUTER BOOKS	301
DIRECT MARKETING CONNECTION			
336	Arlington Computer Products	MAIL ORDER	507
141-481	Bulldog Computer Products	MAIL ORDER SYSTEMS/PRINTERS	514-515
109	Comp. Discount Warehouse (MMC)	MAIL ORDER	518-519
205	Compuclassics	MAIL ORDER	506
300	Computability	MAIL ORDER	523
137	CUC International	MAIL ORDER	522
•	Damark International	MAIL ORDER	517
•	EXCEL MICRO	COMPUTERS/COMPATIBLES	516
352	FASTMICRO	MAIL ORDER	508-509
•	Hard Drives International	MAIL ORDER	521
307	Micro National	MAIL ORDER	510
489	Midwest Computer Works	MAIL ORDER	520
271	Pao-Ku Ltd	MAIL ORDER	513
295	RP Systems	MAIL ORDER	512
349	S & W Computers	MAIL ORDER	524
306	Tenex Computer Express	MAIL ORDER	522
171	Warehouse Data Products	MAIL ORDER	511

EDITORIAL PRODUCT INDEX

PC MAGAZINE Volume 9 Number 17

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
AFTER HOURS			
405	Nutri-Calc HD	Camde Corp.	557
404	Executive Diet Helper	Ohio Distinctive Software	557
404	Menu Planner	Ohio Distinctive Software	557
404	Weight Loss Planner	Ohio Distinctive Software	557
406	Ultima VI	Origin Systems	558
407	FRAC	Max Shapiro, International House	560
COMPUTERS			
	286-based PCs:		
427	Compaq LTE/286	Compaq Computer Corp.	112
428	Sharp PC-6220	Sharp Electronics Corp.	126
429	TravelMate 2000	Texas Instruments	126
542	Toshiba T1200XE	Toshiba America Information Systems Inc.	141
	386- and 386SX-based PCs:		
543	Arima ACT 386SX-420	Arima Computer Corp.	142
544	Compaq XLT 386s/20	Compaq Computer Corp.	147
545	Walkabout/SX	Data General Corp.	148
546	Epson Equity LT-386SX	Epson America Inc.	151
547	GRiD 1450sx	GRiD Systems Corp.	157
548	Impulse SX	Impulse Systems Inc.	162
549	ITC 386 PEP	Intelligence Technology Corp.	167
550	Toshiba T3100SX	Toshiba America Information Systems Inc.	172
601	Twinhead Superlap SX	Twinhead Corp.	175
602	Zenith TurbosPort 386e	Zenith Data Systems	176
439	Compaq SystemPro 486-240	Compaq Computer Corp.	55
440	Business Server 33/386 (ISA)	Advanced Logic Research Inc.	55
441	ES-300C	Epson America Inc.	55
CONNECTIVITY			
409	StarLAN 10 NAU	AT&T Computer Systems	368
410	E2010 (AT) and E3010 (MCA) Ethernet Cards	Cabletron Systems Inc.	373
410	MMAC3 and MMAC8 Hub Chassis	Cabletron Systems Inc.	373
411	David ExpressNET LAN	David Systems Inc.	376
411	David VolksNET LAN	David Systems Inc.	376
412	10BASE Twisted-Pair Adapter	DCA 10NET Communications	381
413	Speedlink/PC16 TP	Everex Systems Inc.	382
414	G/EtherTwist	Gateway Communications Inc.	383
415	HP Ethertwist PC Link	Hewlett-Packard Co.	386
416	PCnic TP Family Card	IMC Networks Corp.	390
417	EtherNext LAN 10BaseT System	NetWorth Inc.	392
418	SMC/3016TP	Standard Microsystems Corp.	395
419	Etherlink II/TP	3Com Corp.	396
420	EtherCard Plus10T	Western Digital Corp.	396
DESKTOP PUBLISHING (Gray-Scale Editors)			
424	Gray F/X	Xerox Imaging Systems Inc.	240
422	ImagEdit	IBM Corp.	247
423	Image-In	Image-In Inc.	251
426	PC Paintbrush IV Plus	ZSoft Corp.	252
421	Picture Publisher	Astral Development Corp.	257
425	ZIP Image Processing	Catenary Systems	260
HARDWARE			
430	Niscan/GS	Niscan Inc.	48
431	Hico A4Color Scanner	ECA C&C Products	48
434	Information Station	Applied Resources Inc.	49
438	LaserMaster OS/2 Printer Driver	LaserMaster Corp.	44
442	IMG-511	Fora Inc.	56
443	AVR 3000/GS	AVR	56
444	NuScan PC Gray Scale Scanner	Asuka Technologies Inc.	56
445	Personal Scan	DEST	56
448	Elefont Desk Cartridge	Elesys Inc.	58
647	VirtualVideo Producer, VGA Version 3.0	V Graph Inc.	49
447	MousePenPortable	APPOINT	58
HARDWARE (Tape Backup)			
603	Alliance QA150-EXAT	Alliance Technology Inc.	286
604	Bi-Tech 150 SCSI Tape Kit QIC	Bi-Tech Enterprises Inc.	292
605	TapeMaster 150E	CMS Enhancements Inc.	292
607	150/-250- Megabyte Tape Drive	Compaq Computer Corp.	302
606	QFA500	Colorado Memory Systems Inc.	300
608	COREtape CT150/250E	CORE International Inc.	303
609	Emerald Systems RapidRecover 150 Model RAP	Emerald Systems Corp.	309
610	Everex Excel Stream 150	Everex Systems Inc.	314
611	Identica IDT150	Identica/Division of Prima International Inc.	314
612	Irwin 6451-E	Irwin Magnetic Systems Inc.	317
613	MaynStream 150Q	Maynard Inc.	317
614	MT-150/DOS	MicroNet Technology Inc.	318
615	FileSafe 7250	Mountain Computer Inc.	320
616	NCR 6091 150 MB SCSI Tape SubSystem	NCR Corp., Peripheral Products Division	320
617	NovaStor NST150	NovaStor Corp.	323
618	Osicom Osibak 150S	Osicom Technologies Inc.	323
619	Sankyo ET 150 E	Sankyo Seiki (America) Inc.	329
620	Sysgen Maxi TS250e	Sysgen Inc.	329
621	FSO 150e	Tallgrass Technologies Corp.	330
622	Panther 150	Tandberg Data Inc.	330
623	Tecmar QT-150e	Tecmar Inc.	334
624	TLC Legacy 150x²	Tense Lectronix Corp.	336
625	Wangtek LS 5150 PK	Wangtek Inc.	338
MODEMS			
437	9600etc/e	ATI Technologies Inc.	55
OPERATING ENVIRONMENTS			
399	DESQview 386, Version 2.2	Quarterdeck Office Systems	196
400	Microsoft Windows, Version 3.0	Microsoft Corp.	202
401	Omniview 386, Version 4.2	Sunny Hill Software	210
402	VM/386 MultiTasker, Version 1.22	IGC	214
403	Vmos/3, Version 1.0k2	Microdyne Corp.	222
PRINTERS			
652	HP LaserJet IIfD	Hewlett Packard Inc.	33
SOFTWARE			
432	Letter Perfect	WordPerfect Corp.	38
433	WordPerfect Thymer	WordPerfect Corp.	38
435	Kappa, Version 1.1	IntelliCorp	50
436	Mewel Version 3.1	Magna Software Systems	44
446	Netware Early Warning System	Frye Computer Systems Inc.	58
449	ARK	Asymetrix Corp.	58
450	Imara	Imara Research Corp.	58
650	Thinx, Version 1.0	Bell Atlantic	43
652	dBase IV, Version 1.1	Ashton-Tate	33
UTILITIES			
648	Companion For WordPerfect, Version 2.0	Psybourne Inc.	46
649	By Design, Version 1.0	Streetwise Software	46
646	The Norton Utilities 5.0	Symantec Corp.	36

PRODUCTIVITY

DEPARTMENT	PROGRAM NAME/DESCRIPTION	PAGE
Lab Notes	PC scanners: Not just for high-end users anymore.	403
Utilities	PCBOOK makes your LaserJet print files in booklet form	425
Environments	Working with metafiles: Modifying and sharing vector-oriented images.	449
Power Programming	The successor to DOS: A look at several possibilities.	461
Windows	One thing to know when running PC Tools under Windows.	471
Windows	Some programs not to execute in a DOS virtual machine.	472
Windows	Why using third-party disk partitioning software can be risky.	475
Databases	Explore database indexing with BASIC, using sequential and random access.	477
Spreadsheets	How to overcome the limitations of Quattro Pro's mouse palette.	483
Spreadsheets	A simple macro that offers an advantage over Excel's Paste Special.	484
Spreadsheets	Valuable keystroke shortcuts that bypass menus and dialog boxes in Excel.	484
The Working Word	An easy way to find out how many times you've used a particular word in any Word document.	487
The Working Word	How to count the occurrence of a word in WordPerfect 5.0 and 5.1.	487
The Working Word	Understand XyWrite's XPL and count words in a snap.	488
The Working Word	How to speed the operation of the line-drawing feature in WordPerfect 4.2 and 5.0.	488
User-to-User	Unscramble SUBST, ASSIGN, and JOIN with TRUENAME, an undocumented DOS 4.x command.	491
User-to-User	A tiny program that makes a Caps Lock key act like the Shift Lock on a typewriter.	492
Tutor	Understand why null-modem cables vary in appearance.	497
Tutor	A program that identifies what type of NOP you have.	498
Connectivity	A tip for logging in to a Novell network.	503
Connectivity	Find out how much speed is needed to link your long-distance LANs.	503
Connectivity	How to avoid the "LOAD VAP" message in NetWare.	504
Connectivity	An easy way to keep the login script from overwriting your path in NetWare.	504

After Hours

Products for the Leisure Side of Personal Computing

Nutrition Software Helps Weight Conscious PC Users Plan and Stick to Diets

PERSONAL FITNESS
by Don Trivette

The PC is increasingly blamed for health problems ranging from carpal tunnel syndrome and eye strain to an increased risk of cancer. Leaving these controversies aside, there is no doubt that the PC can play a very positive role in helping users live a healthier lifestyle. Ohio Distinctive Software and Camde Corp. both publish software that exploits the PC's database and record-keeping capabilities to help health conscious users watch their diets.

Ohio Distinctive Software, based in Columbus, Ohio, markets three PC programs that may help you to slim down and shape up. *The Executive Diet Helper* is a computerized look-up program that gives you the calorie, carbohydrate, protein, fat, and cholesterol content of about 3,000 common foods. The foods are grouped into 22 classifications like soup, seafood, and vegetables. Once you select an appropriate group and type in the food, *EDH* usually displays several choices. For example, "potato" yields various combinations of baked, fried, and boiled legumes. This program was once priced at $100, but is now selling for $20; at the reduced price it may be a useful tool for the dietitian who needs a computerized reference.

The second program, *Menu Planner*, prints a menu of foods based on the number of calories you specify, along with other factors like the risks of diabetes, heart disease, and hypertension. A vegetarian lifestyle can also be taken into account, along with age and pregnancy. Telling the program I wanted a 2,700-calorie-per-day diabetic menu produced dozens of printed recommendations. For lunch, *Menu Planner* suggested an 11.5-ounce tunafish (from a can packed with water) sandwich. I could have substituted a less healthy 9-ounce ham sandwich, but the program warned me that 8 ounces of hot dogs or hamburgers (any type) were a poor choice. *The Menu Planner* also sells for $20.

The *Weight Loss Planner* is four separate programs bundled under a menu. The regular weight loss program determines your ideal weight based on age, size, and gender, and then calculates the daily caloric intake needed to reach that goal. The accelerated weight loss version does the same thing, but in fewer days. The customized version lets you tell it how much you actually eat, and it will tell you how many days (years? decades?) it will take you to reach your ideal weight (if ever). The fourth program calculates calories expended during various types of exercise. The *Weight Loss Planner* sells for $99, but you will do well to wait till it sheds some dollars before you buy it.

All of these programs have antique command structures, no graphics, and limited output. On the positive side, they are easy to run—there's no installation or copying of files; you simply insert the disk and run.

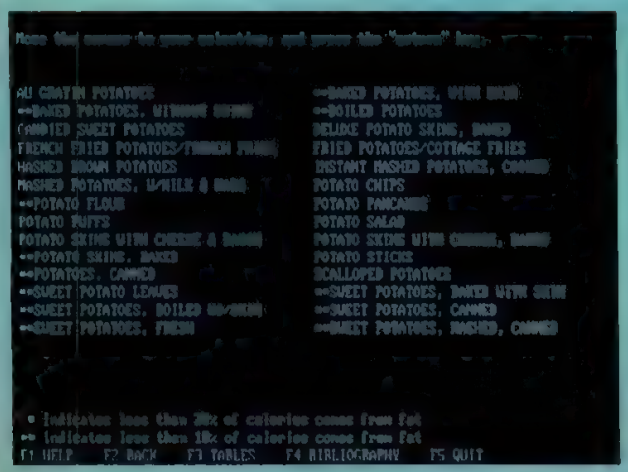
At the other end of the scale is *Nutri-Calc HD*, a $225 program from Camde Corp., a leading vendor of nutritional analysis software. This integrated program analyzes food intake, calculates caloric output based on daily activity, and then pre-

CONTINUES

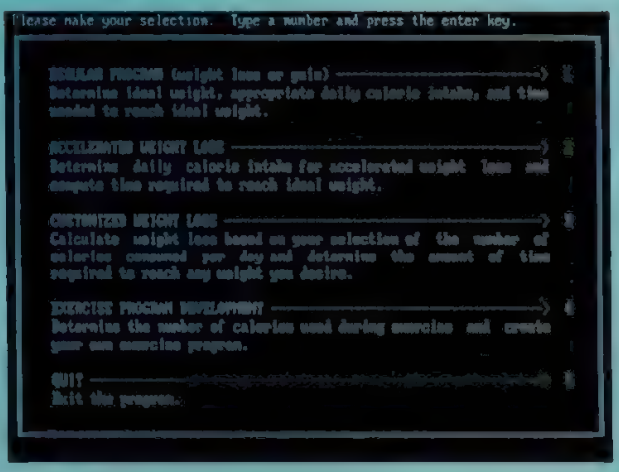
GAMES

Ultima VI: the role-playing saga continues.

FRAC, a shareware program, takes *Tetris* into 3-D space.



The food dictionary of *Executive Diet Helper* contains a variety of foods prepared in a number of different ways.



Weight Loss Planner has four regimens for dropping pounds—which, like all diets, require willpower.

Nutrition

CONTINUED

sents the results as a weight gain/loss plan. The software can store and maintain a caloric history for a large number of individuals, limited only by the computer's memory.

Nutri-Calc HD was recently upgraded to contain a greatly expanded food database, data on four nutrients missing from the previous version, a simpler user interface, and updated values from the new 10th Edition of the Recommended Daily Allowances. The less comprehensive version, *Nutri-Calc PC*, (see After Hours, January 31, 1989) does not require a hard disk and remains available.

The nutrition analysis section is particularly comprehensive, with built-in values for more than 3,400 foods, prepared dishes, and fast-food goodies. The split-screen configuration makes daily food analysis extremely easy. Select the foods from the left column, adjust the quantity or serving size, and the results accumulate in the right column. Press a function key for a detailed analysis of 30 proximates, lipids, vitamins, and minerals along with the RDA value for each of these. You also get a bar graph that instantly shows how you are doing with respect to RDAs, and a pie chart that displays your daily diet as carbohydrates, fat, and protein.

The calorie calculator, called *Calorie Magic*, computes how many calories you need based on body size, age, gender, and activity level. You specify how many hours a day you spend in various activities (for example: 8 in sleeping, 1 in dressing, 1 in eating). If you enter a weight goal and time period, the program computes the daily caloric intake level to reach that goal, but unlike *Menu Planner*, it doesn't offer menu suggestions.

Nutri-Calc HD is intended for professionals like doctors and dietitians, but it can also be used by those knowledgeable in nutrition and willing to pay $225. *Executive Diet Helper*, *Menu Planner*, and *Weight Loss Planner* are for more-budget-minded nutritionists.

List Price: *Executive Diet Helper*, $20; *Menu Planner*, $20; *Weight Loss Planner*, $99. **Requires:** 256K RAM, DOS 2.1 or later; *Menu Planner* requires a printer. Ohio Distinctive Software, 1078-G Merrimar Circle North, P.O. Box 20201, Columbus, OH 43220; (614) 459-0453.

CIRCLE 404 ON READER SERVICE CARD

List Price: *Nutri-Calc HD*, $225. **Requires:** 512K RAM, DOS 2.1 or later, hard disk. Camde Corp., 4435 S. Rural Rd., #331, Tempe, AZ 85282; (602) 821-2310.

CIRCLE 405 ON READER SERVICE CARD

Ultima VI Continues the Story, Adds Hi-res Graphics

GAMES
by Barry Brenesal

Origin Systems' *Ultima I* almost single-handedly set the imaginative standards for role-playing software back in 1980, and each subsequent game in the series has increased the size and detail of *Ultima*'s fantasy world. The quests now require an investment of time and patience almost worthy of the search for the Holy Grail. *Ultima VI*, developed to mark Origin Systems's 10th anniversary, is easily the most complex yet.

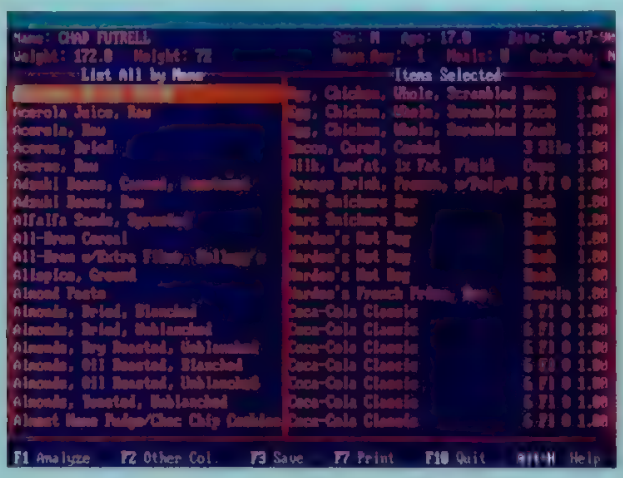
This time, you and assorted friends must save the world of your ruler, Lord British, from an invasion of living, intelligent gargoyles. (You'd think that by now Lord British would have taken the hint, and moved to some quieter neighborhood. But no. . .).

A radical departure from the game's long-familiar visual style sets this *Ultima* well apart from its predecessors. True, Britannia *feels* the same, with cities like Skara Brae and old, familiar characters like Iolo and Lord British, himself. You still visit dungeons, buy and sell weapons, and go on a number of lesser quests in preparation for The Big One. But the kingdom and its environs look completely different now. That might be because this is the first *Ultima* to be developed on a PC, instead of on an Apple. Rumor has it that when series creator Richard Garriott found himself with 640K worth of RAM to play with, he almost had mystical visions.

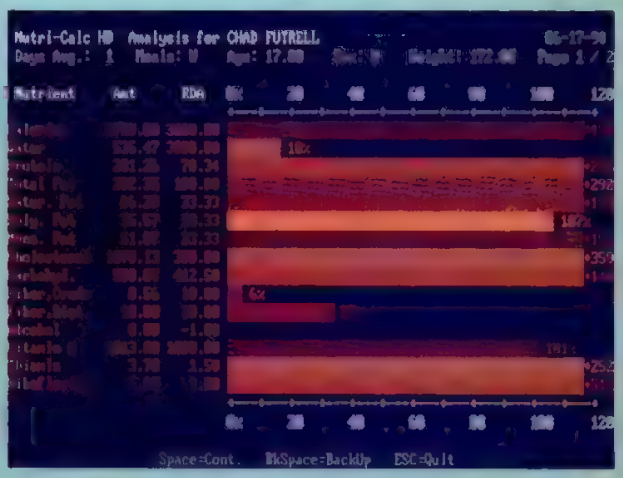
MORE REALISM

Terrain is rendered more realistically and less symbolically. City icons, for example, no longer expand to fill the screen. Instead, characters advance along roads and through woods until buildings stand revealed. Conversing with an *Ultima VI* character brings up an individualized portrait of your interlocutor, in a fashion similar to Origin's *Knights of Legend*. Human figures in distinctive clothing, and monsters in assorted hides move through an attractive, varied landscape. The giant insects are real enough to send you hunting for bug spray, and the hydras are probably as disgusting, pixel for pixel, as any horror film creature I've ever seen. Optional sound cards enhance matters with attractive music and effects.

This substantial overhaul and



Nutri-Calc HD computes the daily intake of a typical 17-year-old male at more than 5,700 calories.



Nutri-Calc HD graphically displays consumption as a percent of Recommended Daily Allowance.

INDEX TO ADVERTISERS

RS #	ADVERTISERS	PAGE
293	3 COM	374-375
521	3M Memory Technologies	322
234	3X USA	47
166	AST Research	136-137
540	ATI Technologies Inc.	256
337	ATI Technologies Inc.	394
296	Attachmate	385
172	Abacus	301
129	Acma Computers, Inc.	40-41
*	Adobe Systems	331-333
165	Advanced Logic Research	32
111	Arche Technologies	145
336	Arlington Computer Products	507
*	Ashton Tate	170-171
*	Ashton Tate	345
509	Austin Computers	9-13
131	Bitstream	197
380	Bloc Publishing	74
203	Bondwell	473
329	Borland International	57
287	Borland International	476
285	Borland International	482
253	Brain Computer Corp	82-83
328	Buffalo Products	224
141/481	Bulldog Computer Products	514-515
273	Bus Computer	159
501	CH Products	248
*	Compu Add	241-244
*	Compu Add	493-496
387	COMPUTERLAND	266-267
185	CONNEXPERTS	324
202	Corel Systems	250
729	Corel Systems/Samna	226
137	CUC International	522
105	Campbell Services Inc.	479
155	Canon, USA	173
187	Canon, USA	451
128	Capital Equipment Corporation	459
749	Central Point Software	70-71
207	CheckFree Technology Inc.	458
473	Colorado Memory Systems, Inc.	316
109	Comp. Discount Warehouse (MMC)	518-519
*	Compaq Computer Corporation	362-363
*	Compaq Computer Corporation	377-380
226	CompuServe Information Service	346
205	Compuclassics	506
300	Computability	523
375	Computer Associates	448
483	ConnectWorks	398
372	Copam U.S.A., Inc.	335
198	Core International	198
*	Curtis Manufacturing	103
747	Cyrix Corp.	161
183	D-Link Systems, Inc.	143
502	DAC Easy, Inc.	75
504	DATASTORM Technologies Inc.	227
278	DCA	20
150	Dresselhaus Computer Products	225
272	DSC Communications	481
*	Damark International	517
*	Dataworld	18-19
532	Dell Computer Corporation	177-190
536	Dell Computer Corporation	C5-C6
*	Dell Computer Corporation	563-564
250/734	Delrina Technology	140
212	Dolch Computers	29
347	Dustin Discount Software	156
*	EXCEL MICRO	516
363	Eastman Kodak	457
*	Epson	258-259
479	Ergo Computing Inc.	132-133
113	Everex / Computer Info Speciaists	440-441
352	FASTMICRO	508-509
232	Fifth Generation	271
236	Fifth Generation	325
286	Fifth Generation	293
224	Franklin Software	86
323	Funk Software	174
305	GUI Clearing House	470
*	Gateway 2000	113-124
146	Gateway Communications	393
506	Generic Software	285
528	hDC Computer Corporation	203
*	Hard Drives International	521
167	Helix Software	51
118	Hercules Computer Technology	265
*	Hewlett Packard Peripheral Group	194-195
*	Hewlett Packard Vectra	64
525	Hyundai	212-213
*	IBM Corp.	110-111
*	IBM Corp.	200-201
*	IBM Lan Marketing	366-367
244	IEF	315
325	IQ Engineering	92
156	Isogon Corp.	21
257	Indigo Software Ltd.	108
374	Intel (PCEO)	54
512	Intel Corporation	465-467
125	Intercon	69
378	Iomega Corporation	204-205
480	Iverson Computer Corporation	96-97
179	Jameco Electronics	474
726	Kansai International	16
220	Kensington Microware Ltd.	427
492	Kye International	249
169	Lyben Computer Systems	336
182	Logitech	253
343	Logitech	255
*	Lotus Development Corporation	400-401
*	Lotus Development	486
*	Lotus Development	261-263
*	Lotus Development	39
154	MathSoft Inc.	67
240	Mountain Computer Inc.	26
263	Macola Inc.	328
*	Mark Williams	68
*	Maxell	308
495	Maynard Electronics	337
317	Megadrive Systems, Inc.	146
307	Micro National	510
225	MicroWarehouse Inc.	310-313
*	Micrografx	72
370	Micron Technology	402
*	Microsoft	305-307
*	Microsoft	460
*	Microsoft	445-447
*	Microsoft	2-3
489	Midwest Computer Works	520
170	Multisoft Corporation	220
*	NEC Technologies, Inc.	1
153	NEC Technologies, Inc.	C2-C4
*	NEC Technologies, Inc.	397
335	NEC Technologies, Inc.	399
*	NEC Technologies, Inc.	246
157	NEC Technologies, Inc.	60-61
*	Northgate Computer Systems	405
*	Northgate Computer Systems	228-235
*	Northgate Computer Systems	407
*	Northgate Computer Systems	419-421
*	Northgate Computer Systems	415-417
*	Northgate Computer Systems	411
*	Northgate Computer Systems	413
*	Northgate Computer Systems	423
*	Northgate Computer Systems	409
213	Norton Lambert	87
322	Novell Data Systems	326-327
362	OCR Systems	149
359	Our Business Machines, Inc.	4
*	Oracle	80
245	Output Technology	127
301	Patton & Patton	94
303	PC Brand	348-357
*	PC Connection	276-281
140	PC Publishing	59
238	Premier Innovations	84
297	Pacific Data Products	264
241	Pacific Data Products	239
122	Panasonic OA	152-154
138	Panasonic OA	297
271	Pao-Ku Ltd.	513
327	Paradise	268
358	Peachtree Software	463
302	Peter Norton Computing	207-209
267	Powercard Supply	454
148	Primavera Systems	459
190	Procom Technology	222
259	QMS	5
338	Quarterdeck Office Systems	45
295	RP Systems	512
290	Rose Electronics	412
124	Roykore, Inc.	475
349	S & W Computers	524
326	Sears Business Centers	223
269	Sitka Corp. (Formerly TOPS)	251
127	Softbank	236
365	STSC	455
135	Sun Microsystems	388-389
*	Seagate	273
490	Seiko Instruments	42
724	Softlogic Solutions	14
*	Software Publishing	469
377	Sony Magnetic Products Co.	298-299
163	Standard Computer Corp.	52-53
161/314	Storage Dimensions	358
268	Swan Technologies	22-25
299	SWFTE	37
312	Tandon Computer Corporation	287-290
284	Tandon Computer Corporation	163-166
508	Tandon Computer Corporation	369-372
289	Tandy Corporation	339
*	Truevision Inc.	319
139	Truevision Inc.	321
391	Tangent Computer, Inc.	107
294	Tatung Company of America	490
384	Tecmar	128-129
123/206	Telemart	88-91
306	Tenex Computer Express	522
177	Texas Instruments	169
304	Texas Instruments	499
379	Toshiba of America	104-105
231	Touchbase Systems	28
204	Traveling Software	150
121	Tri-Star Computer	17
230	US Sage	361
385	US Intergrated Technologies	193
367	Universal Data Systems	502
223	Verbatim	95
101	Verran	365
175	Ventura Software, Inc.	489
171	Warehouse Data Products	511
*	Wordperfect	98
184	Wyse Technology	62
199	XTREE-Div of Executive Systems	485
211	Xircom	340
518	Xyquest	86
732	Zenith Data Systems	424
115	Zeos International	437
721	Zeos International	216-217
487	Zeos International	76-77
388	Zeos International	78
*	Zeos International	48a-h
*	Zeos International	429-436
145	Zeos International	30-31

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Ultima VI

CONTINUED

upgrade is the game's biggest drawing card, but also its chief drawback. All that animation and data (on seven 360K disks!) slows the pace as files load and run. *Ultima VI*, unlike its predecessors, moves glacially at times, even on a 286. With this much information to update, saving games in single data files is no longer possible—and that translates into only one playable game per software installation. A similar trade-off involves the bias toward higher resolution. EGA graphics are curiously blurred and dull at times, while the VGA/MCGA images come through with clarity, detail, and beauty.

It's all part of the price paid for Origin's attempt to push a better wonderland through the front end of a computer terminal. In light of this, the program's major failing is all the more surprising. The game is still unable (an inheritance from previous *Ultimas)* to recognize and respond to changing story conditions. There's a cute talking mouse in the game, for instance, who got killed when my team was ambushed. Lord British himself had taught her to speak, and was very fond of the creature. When I brought her little furry body back to the monarch, all he did was chuckle, and rave again about her accomplishments. Incongruities like this dissipate the "alternate universe" atmosphere which Origin has spent so much time and effort building.

Ultima VI features a more realistic landscape than those of earlier installments in this long-running series, probably because it was developed on a PC, not an Apple.

A NEW INTERFACE

The user interface has been revamped as well, again with mixed results. For the first time, controls are mouse driven, and almost all familiar letter commands are gone. Changing weapons via keyboard (to name one typical activity) is no longer the simple "[R]eady [S]word." Now, you have to choose [TAB], position the icon over the weapon you want, and hit [ENTER]. The accumulating tedium of this is partially offset by several time-saving keyboard shortcuts (unfortunately absent from the documentation or quick reference).

Combat remains elementary compared with many other role-playing games. Your choices are limited to Attack, Move, Switch weapons, or Use item (including your book of spells). One new option changes any of your party (save your own character) into self-guided warriors during combat. While this works well in theory, the implementation isn't perfect. Time and again, several members of my group dropped out of the conflict entirely, as they tried to advance toward the nearest foe. The enemy just happened to be behind an impenetrable 100-foot-long wall.

An A plus for effort on *Ultima VI*, then, and a mixed grade for achievement. People with VGA/MCGA graphics will want *Ultima VI* for its superb use of color, and players of past *Ultimas* will want the game simply because it's *Ultima*. Just as fans of mystery novels devour every new book by a favoritie author, *Ultima* addicts will jump at a fresh chance for swashbuckling adventures.

List Price: *Ultima VI*, $69.95.
Requires: 640K RAM, DOS 3.0 or later, graphics adapter. Mouse, hard drive recommended. Origin Systems, P.O. Box 161570, Austin, TX 78716; (800) 999-4939.

CIRCLE 406 ON READER SERVICE CARD

When you converse with an *Ultima VI* character, his portrait appears on-screen in full color—similar to Origin's *Knights of Legend*.

FRAC Offers Tetris Addicts A Fresh Challenge

GAMES
by Peter Kozodoy

For the last two months I've been addicted to *FRAC*, an exciting new 3-D adaptation of the wildly popular arcade classic, *Tetris*. Like *Tetris*, *FRAC* originated in a foreign country, and game play takes place against an attractive graphical backdrop (in this case, a colorful fractal from the Mandelbrot set). Like other *Tetris* spinoffs such as Spectrum HoloByte's *Welltris* and California Dreams' *Blockout*, *FRAC* expands the basic *Tetris* metaphor into three dimensions.

The object is to efficiently position blocks as they drift slowly down into a well. When a horizontal layer of the well fills up, the layer disappears and the player receives bonus points. More points are awarded for dropping the blocks directly from the top of the well than for letting them simply drift down.

FRAC's shapes are three-dimensional blocks constructed from cubes. They fall toward a 6 by 6 grid on the bottom of a well 13 cubes high. Positioning shapes as they fall is simple, using the keyboard's numeric keypad or the "QWEASDZXC" keys. The middle key rotates the block through the x, y, and z planes; the other keys move it in the horizontal plane. A falling shape's horizontal location is tracked by indicators along the top line of the well. This is very useful because it's often difficult (sometimes almost impossible) to visually determine where in three-dimensional space the blocks are.

There are a variety of play options. You can begin at any level you wish (the level determines the speed of the falling blocks), or increase your level midgame. True masochists can also choose to have a number of layers partially filled before game play begins.

FRAC

CONTINUED

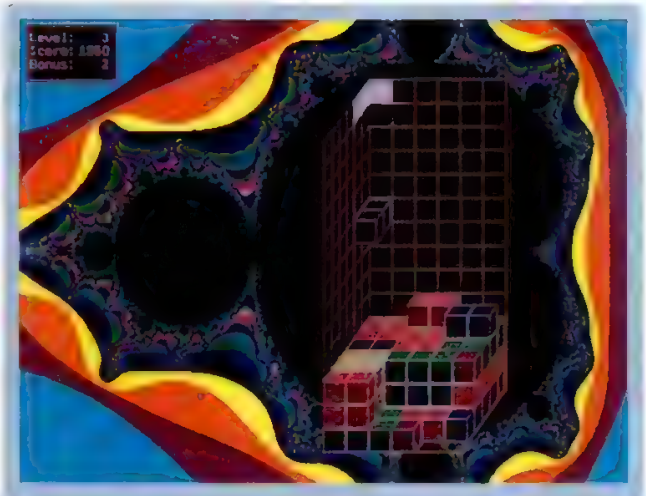
The game is quite difficult enough without adding such complications, however. One tip from a hardened addict: it's important to keep the highest buildup toward the back of the grid. If you don't, you will obscure your view of the game board. Even so, success often rides on your ability to remember where you put previous blocks. And monster blocks like the huge, bright yellow, 3 by 3 by 3 cube always seem to tumble down when you are least prepared for them.

FRAC's three-dimensional graphics are impressive and clear. EGA (with 256K RAM on the graphics card) or VGA graphics are required.

FRAC is a well-done, fun, and extremely habit-forming game. It retains the simplicity and the appeal of *Tetris*, but extends it into another dimension. And here's the best part: it's shareware.

That means you can take advantage of the "try before you buy" philosophy. If you like the game, you send in the registration fee. And if it leaves you cold, you simply delete it. You can also copy the game and pass it along to your friends.

Created by Simsalabim Software of Sweden, it carries only a $10 price tag and is available on bulletin boards everywhere. You can even get it on PC MagNet (it's in the games library of the After Hours forum). If you prefer to get the game on a floppy disk by mail, the price increases to $30. But you'd better act quickly because the good folks at Simsalabim (which is Swedish for "abracadabra") are currently at work on a *four-dimensional* version. ■



***FRAC* extends *Tetris* into three colorful dimensions. The shareware game is available on many bulletin boards, including PC MagNet.**

List Price: *FRAC*, $10 shareware registration or $30 by mail (specify 3.5-inch or 5.25-inch disk). **Requires:** 512K RAM, DOS 2.0 or later, EGA or VGA adapter with 256K RAM. Max Shapiro, International House, 2291 Piedmont Ave., Berkeley, CA 94720. Also available from bulletin boards and PC MagNet, Library 3 of the After Hours forum.

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CIRCLE 158 ON READER SERVICE CARD

by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing

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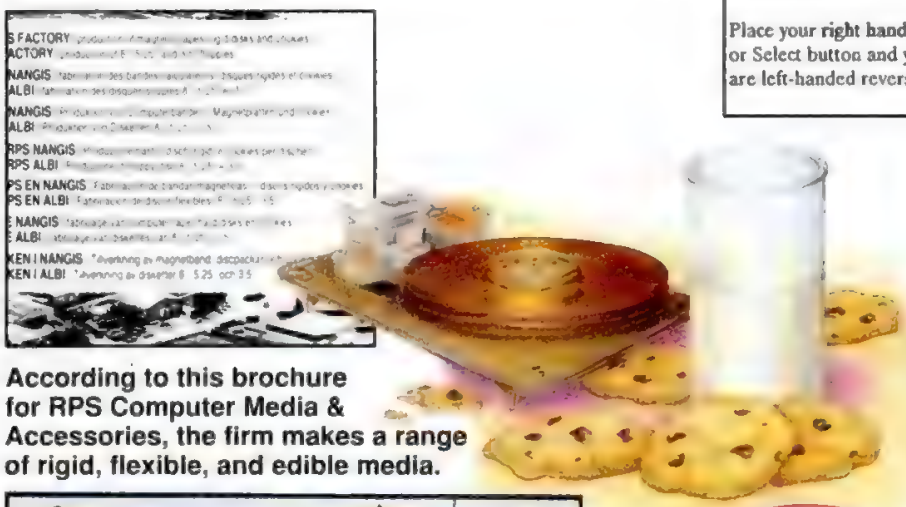
"Accaracy and ommisions" disclaimer at the bottom of the title page of the Oracle *Database Server Evaluation Guide: An Independent Survey by James Buzzard.*

Heck, If You're Left-Handed, Reverse This Advice

Directions for using a two-button mouse, from the Hewlett-Packard Design CAD Workstation Training Manual:

> utton mouse:
>
> Place your right hand on the mouse so that your index finger is on the right, or Select button and your middle finger in on the left or Menu button. If you are left-handed reverse this advice.

ILLUSTRATION: STEPHEN SWENY



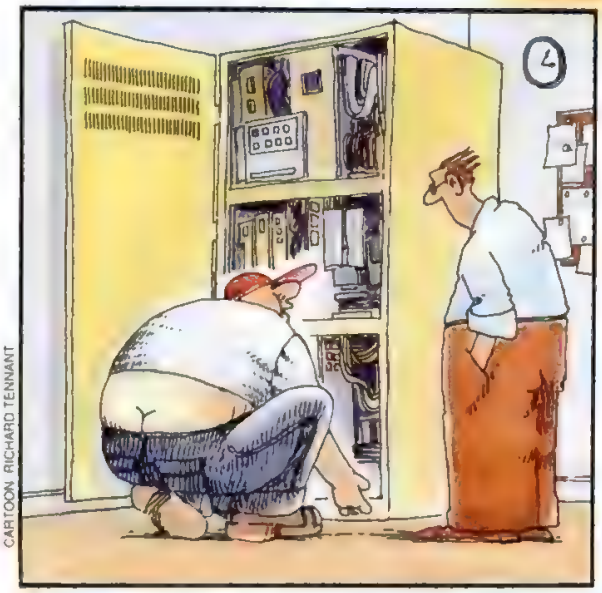
According to this brochure for RPS Computer Media & Accessories, the firm makes a range of rigid, flexible, and edible media.

ILLUSTRATION: JANET PIETROBONO

Propped Up By Unix, 3270 Terminals Gain New Life As Computers

"The five CRTs were replaced with a terminal connected to an IBM 3270 running Unix, which offers access to all the services of the previous five CRTs. It's Unix that ties everything together."

—*Varbusiness*, January 1990.



CARTOON: RICHARD TENNANT

"YEAH, I USED TO WORK ON REFRIGERATORS, WASHING MACHINES, STUFF LIKE THAT - HOW'D YOU GUESS?"

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y accurate and is not limited b
een size. Indeed, tablets capa
ommodating E-size en
ngs are readily

This We've Got to See

From Computer Graphics Review, March 1990.

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness and completeness of entry are considered. Winners this issue: David M. Phillips ("accaracy and omissions"), David Bing (HP mouse instructions), Dominic Toon (rigid disks and cookies), Kurt B. Barthelmess (3270 running Unix), Dave Kunath (tracing by mouse).

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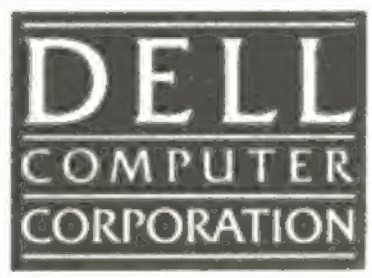

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1. Which products are you most interested in?
☐ 286-based systems ☐ UNIX®-based systems
☐ 386-based systems ☐ Laptops
☐ 386SX-based systems ☐ Other: _____
☐ 486-based systems

2. Are you interested in computer products for:
☐ Home ☐ Business ☐ Resale

3. How many PCs does your company plan to purchase in the next twelve months?

Quantity	Timeframe	Quantity	Timeframe
_____	Less than 1 month	_____	6-12 months
_____	1-3 months	_____	More than 12 months
_____	3-6 months		

4. What do you plan to use computer products for?

_____

_____

_____

5. How many PCs do you have installed now at your company?

_____

6. Are you interested in leasing? ☐ Yes ☐ No

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	Overall Weighted Score	Standard Software Compat.	Display Quality	Overall Reliability	Overall Performance	Keyboard Quality	Product Support Quality	Repair Service Availability	Value Relative To Cost	Overall Functionality As Compared To Desktop PCs	Board-Level Hardware Compat.	Product Support Access.	Quality of Document.
Dell System® 316LT	1st	1st	2nd	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st
Toshiba T3100SX	2nd	2nd	1st	2nd	2nd	2nd	3rd	2nd	2nd	2nd	2nd	2nd	2nd
Zenith SuperSport SX Model 40	3rd	3rd	3rd	3rd	3rd	3rd	2nd	3rd	3rd	3rd	3rd	3rd	3rd

It wasn't very pretty.

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386 Systems, April 10, 1989

Dell PC wins the 4th *PC Week* Corporate Satisfaction Poll.

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